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STUDIES IN MILK SECRETION

IX. On the Performance of the Progeny of Holstein-Friesian Sires

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BULLETIN 300

STUDIES IN MILK SECRETION.

IX. On the Performance of the Progeny of Holstein-Friesian Sires.[1]

By John W. Gowen and Mildred R. Covell.

SUMMARY

This paper is a preliminary paper on the performance of the progeny of Holstein-Friesian advanced registry sires with 365 day records to ascertain the nature of the transmitting power of these sires for milk yield, butter-fat percentage and butter-fat.

Tables are presented to show the progeny performance in average milk yield, butter-fat percentage and butter-fat of all sires having two or more daughters in the advanced registry. These tables present the sires arranged in order of their daughters' average age corrected milk yield, butter-fat percentage and butter-fat. They give the sire's name, the number of his daughters and the relative performance of each daughter.

Similar information is presented for the sons arranged according to their sires.

Five groups of sires were selected. The first contained those sires whose daughters' milk yield was high; the second contained the sires of daughters of low milk yield; the third contained the sires of high butter-fat percentage daughters; and the fourth contained the sires of low butter-fat percentage daughters and the fifth was a group of sires with no advanced registry daughters.

Study of the pedigrees of each of these groups showed low average inbreeding for each group. No significant difference existed between the inbreeding of the different groups.

The relationship between the sire and dam of each sire was slight. Comparison between the five groups showed differences which were of doubtful significance.

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[1]Papers from the Biological Laboratory of the Maine Agricultural Experiment Station, No. 143.

Study of each pedigree group for the individual animals contained therein showed that each group was closely similar to the others in the animals which appeared most frequently within its pedigrees. Such being the case the appearance of a certain famous animal in the pedigree of an unknown bull cannot be taken as indicative of the true worth of the unknown bull as a breeder.

The performance of the progeny of a given sire is today the most frequently applied measure of a sire's worth. This measure while open to the objections raised in a following paragraph has some features of merit. The crying need of cattle breeding today is for knowledge which will enable the breeder to properly choose and control his herd matings to produce superior dairy cows for future milkers. This knowledge, while generally separated into two divisions, is in reality the same in its application and bearing on the whole problem. We need to know how milk yield and butter-fat percentage are inherited and what is the probable constitution of the germ cells of the bulls within the breeds in their capacity to transmit high or low milk production to their offspring. The Maine Agricultural Experiment Station is attempting to approach both of these problems in its Animal Husbandry investigations as carried on by the Biological Laboratory. The methods used are in truth joint methods reflecting one on the other.

To be readily applicable to the needs of the dairyman this knowledge of how to control milk production must be in concrete terms, easily accessible and in a form that allows conclusions to be quickly drawn from it.

The data on the daughters' records as given in the herd books (Holstein- Friesian Association[2]) are tabulated under the names of the sires. They are for all ages of daughters ranging from one and one-half years up to 15 and one-half years of age. The sires are arranged in alphabetical order. In its present arrangement these records have undoubtedly proved very useful as a guide in selecting desirable animals to mate together. Other possible arrangements and reductions of the raw material are perhaps desirable. It would be of interest to have all the ani-

[2]Holstein-Friesian Association of America. 1894-1920. Advanced Registry Year Book 5-30.

mals tested at the same age or in lieu to have the milk records and butter-fat percentage of the daughters of a sire corrected to a constant age. It would be equally desirable to have an arrangement of the average milk yields, etc. of the daughters of a given sire, which would show the breeder the position occupied by the sire in which he was interested.

Such averages make what the breeder calls a tested sire. The record for such a tested sire is open to several more or less grave objections. The milk production of the daughters of a sire is probably more controlled by dominant or partially dominant factors in its inheritance than it is by recessive factors.[3] Such being the case if a bull whose hereditary factors are for low milk production is mated to a cow whose hereditary factors are for high milk yield the resulting female offspring will in all probability have a milk yield intermediate between the two but more nearly similar to that of the dam than it is to that of the sire. In other words the dam and not the sire was responsible for the average milk yield of the sire's daughters. Such being the case, this average daughter's milk yield as a measure of the transmitting qualities of a sire may be false. This difficulty must be realized throughout any work which deals with milk production from the point of view herein set forth.

This measure, despite its defects, proves to be of a good deal of service to the dairy cattle industry. As will be shown in a subsequent bulletin this progeny performance test of the sires of a given bull is correlated with the Daughter-Dam tests of that bull by a significant amount. Further, this amount of correlation is great enough to allow the prediction of what increase or decrease the daughters of a given bull will exhibit in their milk production or butter-fat percentage over the milk production or butter-fat percentage of their dams when the milk yield or butter-fat of the daughters and dams are known. Such being the case this measure of the sire's worth undoubtedly has value when properly used. It has the further advantage of furnishing evidence on a much greater number of sires as to their hereditary factors for milk yield, etc. than is furnished by the

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[3]Gowen, John W.

1920. Inheritance in Crosses of Dairy and Beef Breeds of Cattle, II On the Transmission of Milk Yield to the First Generation. Jour. Heredity, vol. XI, No. 7, pp. 300-316.

real progeny performance test,—the comparison of the amount of milk by which the daughters of a given sire are increased or decreased over the production of their dams.

In this paper it is intended to analize the records of daughters of Holstein-Friesian sires. In a paper to appear shortly the Daughter-Dam test for all possible sires will be presented. It is suggested that these two papers be used jointly. The particular objects of the present paper will be five fold.

(1) To determine mean milk yield for the daughters of Holstein-Friesian sires as shown by the 365 day semi-official records of the Holstein-Friesian Association.

(2) To determine the mean butter-fat percentage for the daughters of Holstein-Friesian sires as shown by these same records.

(3) To determine the mean butter-fat for the daughters of Holstein-Friesian sires.

(4) To determine the mean milk yield, butter-fat percentage and butter-fat of the son's daughters of Holstein-Friesian sires.

(5) Pedigree analysis of the highest group of sires and the lowest group of sires.

In a subsequent paper the transmitting qualities for milk yield, butter-fat percentage and butter-fat for the Holstein-Friesian sires will be presented in a form similar to that of the Jersey sires.[4]

MATERIAL

The data used for this study comprised all the 365 day semi-official records of Holstein-Friesian cows entered in volumes 14 to 31 of the Advanced Register.[5]

The rules under which these tests are made may be found in each volume of the Advanced Register. These rules call for

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[4]Pearl, Raymond, Gowen, John W. and Miner, John Rice.
1919. Studies in Milk Secretion. VII. Transmitting Qualities of Jersey sires for milk yield, butter-fat percentage and butter-fat. Annual Report of the Maine Agricultural Experiment Station for 1919. pp. 89-205.

[5]Holstein-Friesian Association of America.
1903-1919. The Advanced Register Year Book, vol. 14-31.

the supervision of each test by an accredited representative of the agricultural college or experiment station of the state in which the test is made. The rules governing the action of these supervisors are quite inclusive, meeting practically every contingency which might arise in the conduction of the test. The aim of these rules is, of course, the safeguarding of the accuracy of the records. The precaution taken should make this body of data quite accurate.

The information given under each record is as follows:

(1) Name
(2) Advanced registry number
(3) Herd Book number
(4) Volume of last entry
(5) Age of cow at the commencement of her test
(6) Length of the record in days
(7) Pounds and tenths of pounds of milk produced
(8) Butter-fat percentage of this milk
(9) Total pounds of butter-fat contained in the milk

Methods

This investigation includes all bulls having two or more daughters with records 365 days in length. Sires with only one tested daughter were not included because of the great variation of such records due to the agencies of chance. This variation may be seen in table 5 to be of a very considerable magnitude even where two or more records are used. It would of course be much higher with those sires which had only one daughter, in fact so high that little or no reliance could be placed in this measure of a bull's worth as a breeder.

The rules governing the selection of the cow's records were arbitrarily chosen to include the following terms.

(1) If a cow has one 365 day record that record is used.

(2) If a cow has two or more 365 day records the record selected is that nearest 8 years old.

(3) The records of cows less than 365 days in length are omitted from this study. These records will be analyzed in a later paper when other preparatory data are made available.

LAWS GOVERNING THE CHANGES OF MILK FLOW AND BUTTER-FAT PERCENTAGE WITH AGE IN HOLSTEIN-FRIESIAN CATTLE.

In a previous paper from this Laboratory[6] it was shown that the milk yield of Holstein-Friesian cattle changed with age. This change is described by a logarithmic function of the form

$$y=11{,}351.5+873.67x-32.225x^2+1548.36\ Log\ x$$

where y is the mean yearly milk yield and x is the age of the cow.

By the solution of this equation it is possible to determine the amount of correction which should be applied to the milk yields of the different cows to compensate for this rise in the mean milk yield of these cows. For this work the choice of the age which shall be the standard age to which all the milk records are corrected is 8 years. The method of correction may be expressed as this simple proportion:

Corrected milk at standard age : observed milk at a years :: Mean milk at standard age : mean milk at a years.

This method of correction of all the Holstein-Friesian records was employed for each record of the cow as per the rules expressed above.

In the same paper cited above it was shown that butter-fat percentage varies with age, the function describing this variation being linear. On the whole this variation is very slight, amounting to only 0.130 per cent for the whole range. Furthermore the correlation between age and butter-fat percentage for these cows is slight amounting to only $-0.067\pm.013$. This very small correlation and slight change in the mean butter-fat percentage of these cows has made it seem desirable to use the butter-fat percentage just as it is given in the advanced register.

VARIATION OF THE CORRECTED ADVANCED REGISTRY MILK RECORDS OF HOLSTEIN-FRIESIAN COWS

In any investigation it is generally worth while to know what variation may be expected to occur through the agency of

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[6]Gowen, John W.
1920. Studies in Milk Secretion VIII. On the Influence of Age on Milk Yield and Butter-Fat Percentage, as determined from the 365 day records of Holstein-Friesian Cattle. In Annual Report of the Maine Agricultural Experiment Station for 1920. Bulletin 293.

chance. A knowledge of this variation requires a knowledge of the frequency distributions of the variables. In this paper these variables are milk yield and the butter-fat percentage contained in this milk. The number of cows for each given amount of milk, frequency distribution, is shown in table 1. The constants determined from this distribution appear in table 2. The frequency curves for milk yield and butter-fat percentage appear in figures 44 and 45.

TABLE 1.

Frequency distributions of corrected milk yield of the 365 day period for Holstein-Friesian Advanced Registry cows.

Milk Yield, Pounds	365 Day Frequency	Milk Yield, Pounds	365 Day Frequency
9000–10000	1	23000	131
10000	12	24000	96
11000	27	25000	68
12000	62	26000	55
13000	110	27000	42
14000	166	28000	32
15000	238	29000	17
16000	210	30000	18
17000	262	31000	12
18000	243	32000	4
19000	280	33000	2
20000	217	34000	1
21000	163	35000–36000	1
22000	155	Total	2625

The constants derived from this table are given in table 2.

TABLE 2.

Physical Constants for the Corrected 365 day milk yield of Holstein-Friesian cows, the frequencies for which are shown in table 1.

Mean	Standard Deviation	Coefficient of Variation	Octile						
			1st	2nd	3rd	4th	5th	6th	7th
10288.6±54.6	4147.6±38.6	21.50±.21	14700	16192	17604	18924	20137	21863	24207

The constants of table 2 furnish some information relative to the advanced registry of the Holstein-Friesian breed. The milk yield which these cows are expected to produce when in

their mature form (8 years) was 19288.6 pounds of milk for the year period. The standard deviation shows that there is a wide scatter in the milk yields of the individual cows around this average milk yield. This variation amounted to 4147.6 pounds. The percentage of this variation to the mean, (the coefficient of variation) is high compared with that of the butter-fat percentage of these same cows as presented in table 4.

In recording the milk yield or butter-fat percentage for the daughters of the different sires it is desirable to have them recorded in few classes to show the place occupied by each daughter in the whole range of daughters. This may be accomplished by dividing the number of daughters into equal parts and determining the limits of the parts and what the milk yield of these daughters must be, to fall into any one of them. For this study the number of daughters were divided into eight equal numbers of daughters or each part has one-eighth the total number. The milk yields recorded under octiles of table 2 give the place of division between each of these eight equal numbers of daughters. Thus all daughters whose milk yield is below 14700 pounds will be in the lowest group or octile. These octiles are lettered as described in a subsequent section.

The data presented in table 2 on the standard deviations of milk yield together with that of table 4 on the standard deviations of the butter-fat percentage furnish the necessary information for the probable errors calculated in table 5.

VARIATION OF THE BUTTER-FAT PERCENTAGE OF HOLSTEIN-FRIESIAN ADVANCED REGISTRY COWS

The frequency distribution of the 365 day butter-fat percentage records are presented in table 3. The distributions are shown graphically in figure 45.

Table 4 shows that the mean butter-fat percentage of these advanced registry cows was 3.430. This agrees well with that for all the advanced registry cows, test or retest, given in the former paper on the butter-fat percentage variation for this breed. The standard deviation is likewise practically the same as that for the whole group. The places at which the frequency for all the daughters' butter-fat percentage records are divided are such that each division will contain one-eighth the whole

population. These division points are shown under octiles. Thus, those daughters who have butter-fat percentage for the year test below 3.090 belong in the lowest testing eighth of the whole Holstein-Friesian advanced registry cows.

TABLE 3.

Frequency distributions of expected butter-fat percentage of the 365 day period for Holstein-Friesian cows.

Butter-Fat Percentage	365 Day Frequency	Butter-Fat Percentage	365 Day Frequency
2.5–2.6	2	3.8	104
2.6	9	3.9	69
2.7	30	4.0	45
2.8	48	4.1	35
2.9	90	4.2	21
3.0	165	4.3	15
3.1	261	4.4	7
3.2	303	4.5	5
3.3	382	4.6	1
3.4	347	4.7	
3.5	300	4.8	
3.6	226	4.9–5.0	
3.7	160		
		Total	2625

The constants for these distributions are given in table 4.

TABLE 4.

Physical Constants for this Expected Butter-Fat Percentage of Holstein-Friesian Cows, the Frequencies for which are shown in table 5.

Mean	Standard Deviation	Coefficient of Variation	Octile						
			1st	2nd	3rd	4th	5th	6th	7th
3.430±.004	0.315±.003	9.18±.09	3.090	3.217	3.320	3.406	3.501	3.614	3.784

The standard deviations given in tables 2 and 4 furnish the data necessary to determine the probable errors of the mean milk yield, mean butter-fat percentage and mean butter-fat of a sire as determined from his daughters records. It has seemed best in these calculations to use the standard deviations of the

whole populations rather than the standard deviations of the individual sires' daughters, as it is felt that by so doing a more nearly true value of the probable error is obtained. The calculation of these probable errors for the milk yield and butter-fat percentage is a straight forward process. The calculation of the probable error of the net change of butter-fat can be made by the use of the following formula

$$M_1 M_2 \sqrt{v_1^2 + v_2^2 + 2r_{12} v_1 v_2}$$

Where M_1 equals the mean milk yield, M_2 the mean butter-fat percentage, v_1 the coefficient of variation of the milk yield divided by 100, v_2 the coefficient of variation of butter-fat percentage divided by 100 and r the correlation coefficient. The correlation between butter-fat percentage and milk yield in Holstein-Friesian cattle is so low that it may be considered zero in these calculations.

The probable errors have been tabled for only the full year length of lactation.

Table 5 gives the probable errors as derived from the formula cited.

In table 5 under *No.* are recorded the number of daughters which are averaged to determine progeny performance of a sire. The three succeeding columns give the probable errors for milk yield, butter-fat percentage and net butter-fat.

The probable errors of table 5 show that little reliance can be placed in the average milk yield of a bull with only two daughters. The probable chance deviation for such a record would be 1978.2 and the amount of deviation of the average record of the bull's daughters would have to be not less than 5934.6 pounds of milk to be significant. The probable error for a bull's average butter-fat percentage with two daughters is 0.150. The significant difference for butter-fat percentage must consequently be not less than .450 per cent. The probable error of the net butter-fat is 73.78 for two daughters and the deviation to be significant must be not less than 221.34 pounds.

The probable errors of those sires which have a large number of daughters become much smaller. Thus for a bull with fifty daughters the probable error is 395.6 pounds for the aver-

TABLE 5.

Holstein-Friesian corrected Yearly records. Probable errors of the Mean Progeny performance of Holstein-Friesian Sires.

No. of Daughters	Milk Yield	Butter-Fat Percentage	Butter-Fat
	365 day	365 day	365 day
2	1978.2	0.150	73.78
3	1615.2	.123	60.24
4	1398.8	.106	52.17
5	1251.1	.095	46.66
6	1142.1	.087	42.60
7	1057.4	.080	39.44
8	989.1	.075	36.89
9	932.5	.071	34.78
10	884.7	.067	33.00
11	843.5	.064	31.46
12	807.6	.061	30.12
13	775.9	.059	28.94
14	747.7	.057	27.89
15	722.3	.055	26.94
16	699.4	.053	26.09
17	678.5	.051	25.31
18	659.4	.050	24.59
19	641.8	.049	23.94
20	625.5	.047	23.33
21	610.5	.046	22.77
22	596.4	.045	22.25
23	583.3	.044	21.76
24	571.0	.043	21.30
25	559.5	.042	20.87
26	548.6	.042	20.46
27	538.4	.041	20.08
28	528.7	.040	19.72
29	519.5	.039	19.38
30	510.7	.039	19.05
31	502.4	.038	18.74
32	494.5	.038	18.44
33	487.0	.037	18.16
34	479.8	.036	17.89
35	472.9	.036	17.64
36	466.2	.035	17.39
37	459.9	.035	17.15
38	453.8	.034	16.93
39	447.9	.034	16.71
40	442.3	.034	16.50
41	436.9	.033	16.30
42	431.7	.033	16.10
43	426.6	.032	15.91
44	421.7	.032	15.73
45	417.0	.032	15.55
46	412.5	.031	15.38
47	408.0	.031	15.22
48	403.8	.031	15.06
49	399.7	.030	14.91
50	395.6	.030	14.76

age milk yield, 0.030 per cent for the average butter-fat percentage and 14.76 pounds for the average butter-fat.

In balancing the true worth of a bull it is perhaps more essential to take proper cognizance of these probable errors than of the actual amounts of milk produced by his daughters.

THE RELATIVE MILK YIELDS AND BUTTER-FAT PERCENTAGES OF THE DAUGHTERS OF A GIVEN SIRE

It is possible to record the daughters of a given bull together with their actual corrected records for milk yield, butter-fat percentage and butter-fat. This method of recording is similar to that used in the advanced register. Undoubtedly it has merits. It also presents difficulties, chief among which, is the bulkiness of the records. This bulkiness makes it hard to appreciate what the real meaning of the records may be. It is psychologically almost impossible to appreciate and properly balance such records for a number of bulls to determine the bull's relative worth.

To overcome this difficulty the author has arranged the records of all the daughters of all the different bulls in the frequency distributions shown in tables 1 and 3. These frequency distributions were divided so that exactly one-eighth the number of daughters fall in each division, the lowest being in the lowest division, the highest in the highest division for milk yield or butter-fat percentage. The lines making these divisions are called octiles lines. The amount of milk yield or butter-fat percentage which divide the distributions into the eight equal parts is given in tables 2 and 4. These divisions are shown in figures 44 and 45.

The highest of these divisions occurs at a milk yield of 24207 pounds for the records of 365 days duration. All cows having records over this amount of milk are therefore in the first octile or *I*. The second octile, octile *J*, includes the records of those cows between the milk yields of 21863 and 24207 pounds. These are the second best cows. The third best cows are placed in the third group, or octile *K* and have milk yields between the limits of 20137 and 21863 pounds. The fourth best cows are placed in the fourth group, or octile *L*, and have milk yields between the limit 18924 and 20137 pounds. The fifth best cows are placed in the fifth group, or octile *M*, and have milk yields between the limits 17604 and 18924 pounds. The sixth best group of cows have a milk yield between 16192 and 17604 pounds and are called *N*. The seventh group or those next to the poorest group of cows have a milk yield between the limits 14700 and 16192 pounds of milk and are called *O*. The eighth

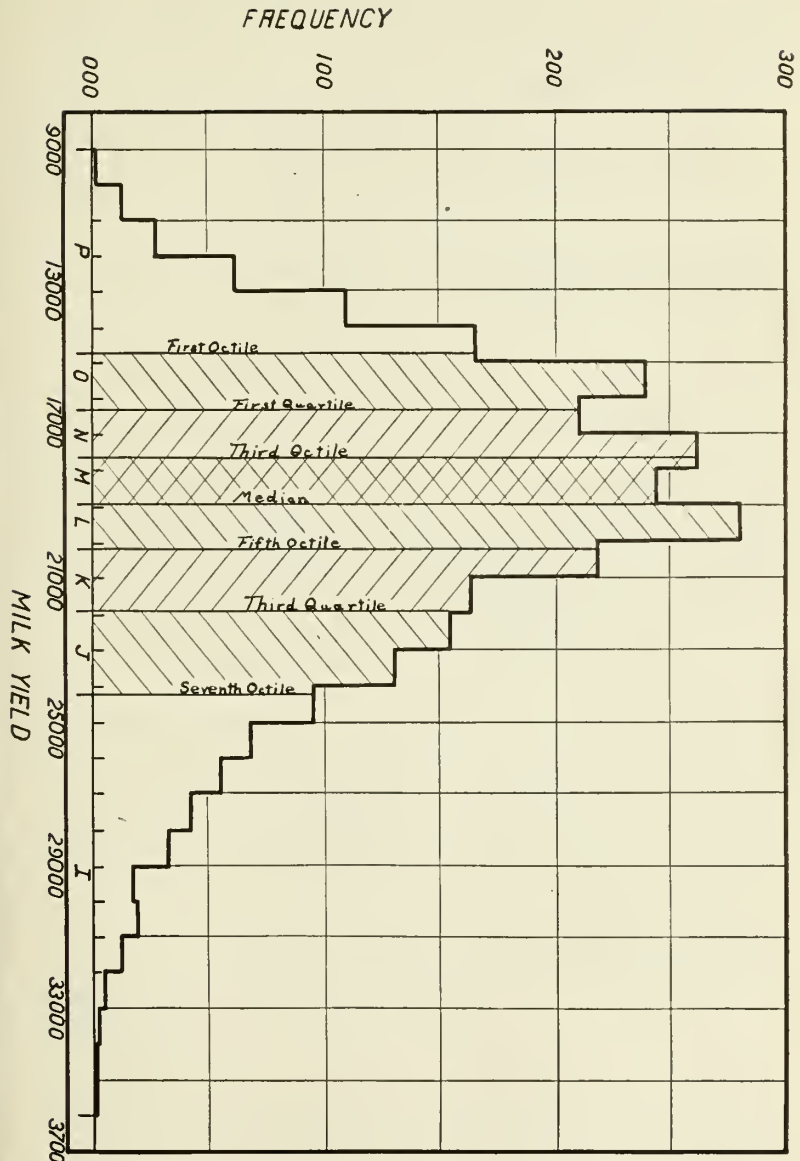

FIG. 44. Histogram showing the frequency distribution of corrected milk yield for Holstein-Friesian advanced registry cows. The octile lines divide these distributions into eight equal parts. These parts are lettered as shown at the bottom of the figure and these letters are used to designate the relative milk yields of a sire's daughters.

group of cows or the poorest have a milk yield below 14700 pounds and are called *P*. These groups are all equal in numbers as mentioned before.

To better illustrate the use of these groups let us suppose a sire has two daughters, one with a milk yield of 25600 pounds the other with a milk yield of 18500 pounds. The first daughter would have a milk yield over 24207 pounds so she would be called *I*. The second daughter's milk yield would be between 17604 and 18924 and would consequently be called *M*. The record for the sire would be

1 I + 1 M

Now it is often desirable to be able to compare the proportionate number of different class daughters of one sire with the proportionate number of different class daughters of another group. To allow of such a comparison the base 100 has been adopted and the records given are the proportionate number of *I, J,* etc. which occur. Thus, in the illustrative record the *1 I* + *1 M* would be recorded.

50 I + 50 M

Such a scheme allows the ready comparison of the records of any sire's daughters with those of any other and also the comparison of any class with any other class.

The arrangement of the butter-fat percentage for the 365 day test is similar to that for the milk. The limits are given as the octiles in table 4 and may be repeated here for sake of clarity.

3.784 butter-fat percentage and above = highest group or *I*
3.614 butter-fat percentage to 3.784 butter-fat percentage = 2nd highest group or *J*
3.501 butter-fat percentage to 3.614 butter-fat percentage = 3rd highest group or *K*
3.406 butter-fat percentage to 3.501 butter-fat percentage = 4th highest group or *L*
3.320 butter-fat percentage to 3.406 butter-fat percentage = 5th highest group or *M*
3.217 butter-fat percentage to 3.320 butter-fat percentage = 6th highest group or *N*
3.090 butter-fat percentage to 3.217 butter-fat percentage = 7th highest group or *O*
Below 3.090 butter-fat percentage = 8th or lowest group or *P*

If we have a sire of three daughters with butter-fat percentage of 3.640, 3.218 and 3.000 the place occupied by these records will be *J* for the first, *N* for the second and *P* for the last or the record will be written

$$33\,J + 33\,N + 33\,P$$

This put into words says that the sire had 33 per cent of his daughters in the next to the highest butter-fat percentage group, 33 per cent in the sixth butter-fat percentage group and 33 per cent in the poorest or lowest testing group.

The histogram showing these divisions is shown in figure 45.

Pedigree Methods

For many breeders the milk yield or butter-fat percentage of a sire's daughters measure for him the value of that bull. Such being the case, it is instructive to examine the pedigrees of those bulls which have daughters with a high milk yield as compared with sires whose daughters have a low milk yield etc. These classified lists may be made by comparing the milk yield of the daughters with the average of the breed in comparison with the probable errors as presented in table 5. The constants determined for these pedigrees are the amount of inbreeding and the degree or amount of relationship which exists between the parents of the sire under consideration. The methods used have been amply discussed in a series of papers from this laboratory[7] and need only be briefly discussed here.

Inbreeding in these studies is defined as the condition or state in which an organism has in fact fewer different ancestors than the maximum number possible.

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[7]Pearl, Raymond.

1913. A Contribution toward an analysis of the problem of inbreeding. In Amer. Nat. v. XLVII, p. 577-614.

1917. Studies on Inbreeding. VII. Some further considerations regarding the measurement and numerical expression of degrees of kinship. In Amer. Nat. v. LI, p. 545-559.

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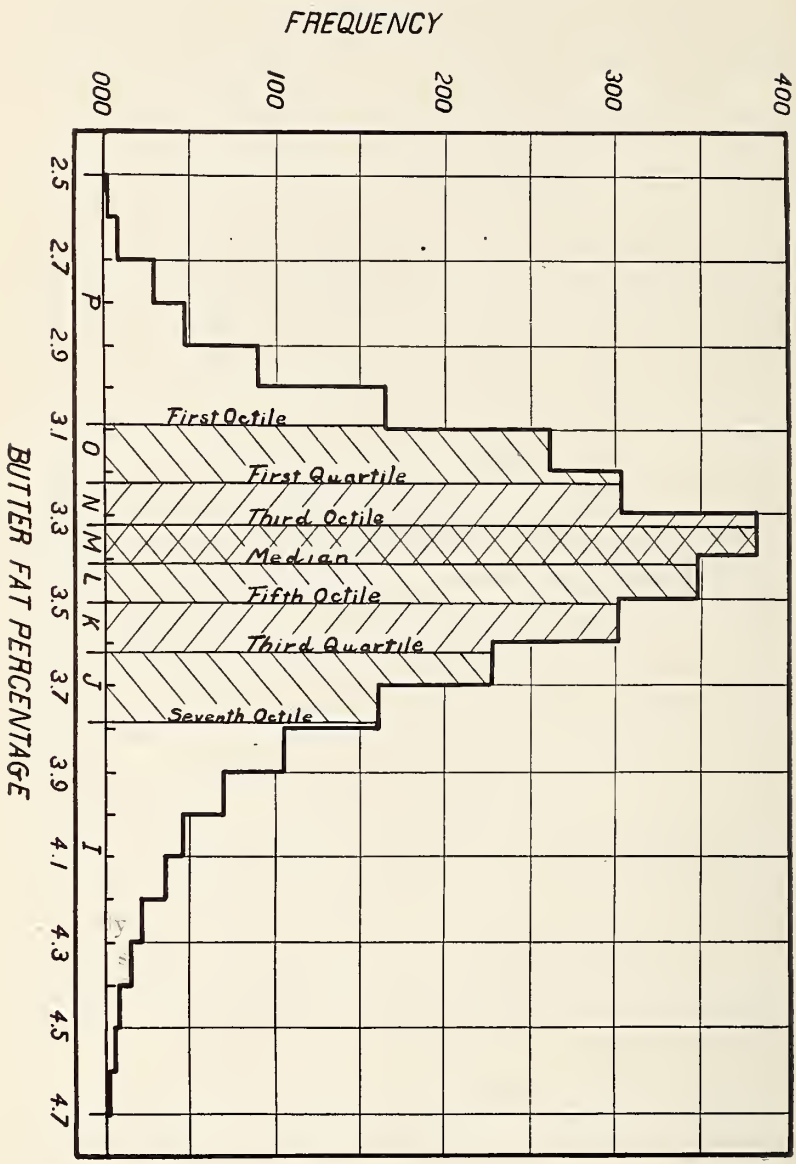

FIG. 45. Histogram showing the frequency distribution of 365 day butter-fat percentage for Holstein-Friesian advanced registry cows. The octile lines divide these distributions into eight equal parts. These parts are lettered as shown at the bottom of the figure. The letters are used to designate the relative butter-fat percentages of a sire's daughters.

The degree or amount of inbreeding (total) is measured by a series of inbreeding coefficients, one for each ancestral generation, defined by the following equation:

$$Z_n = \frac{100\ (P_{n+1} - q_{n+1})}{P_{n+1}}$$

where P_{n+1} denotes the maximum possible number of different individuals involved in the matings of the n+1 generation, q_{n+1} the actual number of different individuals involved in these matings, and Z_n is the inbreeding coefficient for the n+1, the ancestral generation.

The amount of inbreeding may be expressed as a single numerical quantity by referring the inbreeding as expressed for each generation to the maximum possible inbreeding of a brother and sister mating. The formula by which this single measure of inbreeding is determined is

$$Z_{T_n} = \frac{100 \sum_{z_1}^{z_n}}{F_{T_n}}$$

where Σ denotes summation of all values between the inclusive limits indicated, F_{T_n} is the total area of the maximum brother x sister curve up to and including the n+1th generation. Z_{T_n} is the measure of the inbreeding.

A state or condition of relationship or kinship between two organisms exists when these organisms have one or more common ancestors. The degree, intensity or closeness of the relationship is, in general, proportional to the number of different ancestors which the two individuals have in common, out of the whole number they might possibly have in common.

The degree or amount of relationship, in accordance with the above definition, is numerically measured by relationship coefficients, one for each ancestral generation. The coefficients are calculated in two slightly different ways according to whether they are being evaluated in connection with inbreeding coefficients, which will usually be the case, or independently.

When calculated in connection with inbreeding coefficients, a relationship coefficient is calculated in accordance with the following equation:

$$\frac{Kn}{100} = \frac{(pn+1 - qn+1) - (sZn-1\ sPn + dZn-1\ dPn)}{\frac{1}{2}\ Pn+1}$$

where the letters have the same significance as in the above equation with the additions that K denotes a relationship coefficient, a prefixed subscript, s, means that letters following it refer to the pedigree of the sire only, and a prefixed subscript, d, means that the letters following refer to the pedigree of the dam only.

The pedigrees are further studied to determine what the names and numbers of the animals are which appear in them. This information is classified for each group of the pedigrees into three divisions; the sex of the animal; the side of the pedigree (sire or dam) and the generation of the pedigree in which the appearance was made.

Some knowledge of the variations of these constants due to chance is desirable before using them for any extensive study of the inbreeding. In determining this variation, it was thought best to use all pedigrees available. One hundred and seventy-four pedigrees for these Holstein-Friesian sires were analyzed by these methods for this study and the one which is to follow on the daughter dam test. This number is adequate to determine approximately the variation which is likely to occur. The standard deviations of the various constants calculated from the 174 pedigrees are Z_1 4.91, Z_2 7.11, Z_3 9.05, Z_{T_s} 10.46, K_2 9.12, K_3 12.96, and K_4 14.77.

PROGENY PERFORMANCE OF HOLSTEIN-FRIESIAN SIRES' DAUGHTERS FOR MILK YIELD

In table 6 is given the mean milk yield of the daughters of those Holstein-Friesian sires which have two or more daughters with complete 365 day tests in the advanced registry. These daughters' mean milk yields are arranged in order of their

amounts from the highest to the lowest. The number at the right hand side of the table represents the place taken by the mean milk yield of the sires' daughters in the table. The following column gives the sire's name. The next coulmn gives the Herd book number of the sire. In the following column under number of daughters is recorded the number of daughters whose records are averaged to give the record of the given sire. Under milk is recorded the mean or average amount of milk produced by the daughters of the given sire. In the column whose heading is octiles is recorded the number of daughters and the percentage of their total numbers which fall into the given octile as explained in the preceding section of the paper.

Thus to take the first recorded sire. The 1 at the left indicates that his daughters had a higher average age corrected milk yield than did the daughters of any sire. The name of this sire is King Hengerveld Aaggie Fayne. His Herd book number is 56635. This sire has 3 daughters who have 365 day records, as shown in the column marked number of daughters. The average age corrected milk yield of these daughters was 28401.7 pounds. The daughters were 67 per cent or two-thirds in the *I* class or highest group of milk producers and 33 per cent or one-third in the *J* class or the next highest group of milk producers. The coefficient of the eight lettered octiles represent the percentage of the different kinds of daughters which a given bull got from any dams to which he was mated. The place in the curve occupied by the lettered classes is shown in figure 44. Table 6 presents the information on the performance of the progeny of 449 Holstein-Friesian sires whose daughters have year tests.

TABLE 6.

Performance of the Progeny of Holstein-Friesian Sires for Milk Production.

No.	Name	H. B. No.	No. of Daughters	Milk	Octiles
1	King Hengerveld Aaggie Fayne	56635	3	28401.7	67I+33J
2	Piebe Laura Ollie Homestead King	110474	3	28384.7	100 I
3	King Segis Pontiac Count	93909	10	28219.1	100 I
4	Cornucopia Pontiac Johanna Lad	48355	2	27821.5	100 I
5	King Segis Beets	48702	3	27812.0	100 I
6	Duke Ormsby DeKol Creamelle	63578	2	27143.0	50 I+50L
7	King Palmyra Fayne	72099	2	27035.0	50I+50J
8	Cornucopia Waukasha Prince	35119	2	27030.5	100I
9	White Segis DeKol	78027	2	26899.0	100I
10	Colantha Johanna Champion	45674	4	26894.5	75I+25J
11	Linden Butter Boy Pietertje	54120	3	26824.0	67I+33J
12	Wachusett Creamelle George	41803	2	26474.5	100I
13	Iowana Sir Ollie	114797	2	26459.5	50I+50K
14	Masterpiece	84099	4	26186.5	100I
15	Wit Segis Abbekerk	85556	2	26183.5	100I
16	Spring Farm King Pontiac 6th	103899	5	25956.0	80I+20J
17	Sir Korndyke Bess	110157	2	25948.0	50I+50J
18	Sir Johanna Ruth Fayne	53055	2	25729.0	50I+50L
19	Johanna McKinley Segis	44367	2	25675.0	50I+50J
20	Ormsby Korndyke Lad	102469	4	25626.8	75I+25K
21	Count King	59660	2	25595.0	50I+50J
22	Friend Hengerveld DeKol Butter Boy	29303	5	25516.6	80I+20K
23	Emblagaard Prince	89596	4	25512.3	100I
24	Sir Jolie Johanna	36664	3	25367.3	67I+33N
25	The Milk and Butter King	41114	2	25302.5	50I+50K
26	Johanna Bonheur Champion	94984	2	25233.0	50I+50J
27	Tehee Lilith Pauline DeKol	36636	2	25064.0	50I+50L
28	Dutchland Sir Pietertje Hengerveld	48696	3	25020.0	33I+33J+33K
29	Pontiac Burke	33979	2	24954.0	50I+50J
30	Sir Pietertje Ormsby Mercedes 14th	81142	2	24844.0	50I+50J
31	Sir Corcordia Korndyke	75012	5	24780.6	80I+20M
32	Colantha Johanna Lad	32481	8	24732.1	75I+13J+13L
33	Walker Korndyke Segis	50347	2	24731.5	50I+50K
34	King of the Black & Whites	83354	2	24564.0	50I+50K
35	Mercedes Cornucopia Count	44742	2	24408.0	100I
36	Sir Ormsby Skylark	47010	3	24374.0	33I+33J+33L
37	Pietertje Hengerveld Sir Korndyke	60966	8	24327.1	63I+13J+13K+13M
38	Aaggie 3d's Wayne's Paul DeKol	27868	4	24154.8	50I+25K+25M
39	Sir Longfield DeKol	36389	4	24051.0	25I+25J+50K
40	King Walker	40358	8	23797.9	50I+13J+13K+13L+13M
41	Korndyke Butter Boy	38496	2	23699.0	50I+50K
42	Butter Boy Sir Mechthilde	37302	3	23683.7	33I+67J
43	Segis Pontiac DeKol Burke	97472	5	23600.8	60I+20J+20L
44	King Beauty Pietertje DeKol	50758	2	23537.0	50I+50M
45	King Segis Pontiac Aleartra	79602	2	23494.5	50I+50J
46	Upland Johanna DeKol	57256	2	23486.0	50I+50K
47	Aaggie Cornucopia Johanna Lad Jr.	36974	9	23454.7	33I+44J+11L+11N
48	King Pietertje Cloverdale	69686	4	23428.8	50I+25J+25K
49	Mooie Fayne DeKol	38595	2	23423.5	100J
50	Paul Beets DeKol	22235	3	23408.0	33I+33J+33K
51	Johanna de Pauline 2d's Lad	28301	4	23329.8	50I+50K
52	Homestead Girl DeKol Sarcastic Lad	32558	17	23276.9	35I+35J+12K+12L+6N

Performance of the Progeny of Holstein-Friesian Sires for Milk Production.—Continued.

No.	Name	H. B. No.	No. of Daughters	Milk	Octiles
53	Count Pietertje Hengerveld DeKol	41757	2	23191.5	100J
54	Rose Hall Pontiac Pietertje	59959	2	23187.0	50I+50L
55	Johanna Rue 3d's Lad	26939	5	23132.8	40I+20J+20M+20 O
56	Judge Hengerveld DeKol	43964	2	23063.0	50I+50K
57	Piebe Champion	60577	5	23057.4	100J
58	Cor-Will Colantha Paul DeKol	52791	3	22985.3	100J
59	Quirinus Cornucopia	60751	6	22954.5	33I+17J+17K+17L+17N
60	Aaggie Grace Sir Butter Boy	62239	3	22904.0	33I+33J+33L
61	Spring Brook Hengerveld Parthenea	68946	4	22897.3	50I+25L+25M
62	Sindt Butter Boy	55237	3	22861.3	33I+33J+33L
63	Pontiac Aaggie Korndyke	38291	14	22787.1	14I+64J+7K+7L+7M
64	Pride DeKol of Wayside	45895	2	22669.0	50J+50K
65	DeKol 2d's Mutual Paul	25700	2	22650.5	50J+50K
66	King Pontiac Champion	53418	20	22620.3	20I+50J+15K+5M+5N+5 O
67	Maple Crest Pontiac Hartog	62178	5	22584.6	20I+40J+40K
68	Sir Johanna Piebe	53257	13	22516.8	23I+38J+15K+8L+15M
69	Johanna Colantha Sarcastic Lad	38402	9	22501.3	22I+33J+44L
70	King Segis Pontiac Pietertje	48358	4	22477.8	75J+25K
71	Johanna Sarcastic Paul	30551	2	22475.0	50I+50L
72	Johanna Colantha's Lad	28296	4	22431.5	25I+25J+50K
73	Riverview Hengerveld	93371	2	22403.5	50J+50K
74	Prince Gelsche Walker	81663	6	22401.7	17I+33J+33K+17M
75	Prince Johanna DeKol	31168	2	22390.0	50I+50 O
76	King of the Hengervelds	44465	2	22328.0	50I+50N
77	Sir Johanna Fayne	42147	18	22279.6	22I+33J+17K+6L+11M+11N
78	Sir Johanna Canary DeKol	44034	3	22275.0	33I+67K
79	Gem Pietertje Paul DeKol	27282	2	22268.0	50I+50K
80	King of the Pontiacs	39037	37	22182.7	16I+41J+22K+8L+5M+5N+3 O
81	Pontiac Cornucopia Coronis	51148	2	22071.5	100J
82	Riverside King	49297	2	22053.5	50I+50N
83	Korndyke Netherland Wayne DeKol	47306	2	22016.0	50J+50K
84	Prince Nudine DeKol 2d Aaggie	62483	2	21991.5	50J+50K
85	Cornucopia Monarch Vale	59156	2	21970.0	50I+50L
86	Anselmo	41866	2	21964.5	50J+50K
87	Hazelwood Korndyke Gerben	98063	2	21957.5	50J+50K
88	Sir Hengerveld Model Johanna	40338	10	21945.9	40I+20K+20L+20M
89	Homestead Hengerveld Crown DeKol	26345	3	21888.0	33I+33K+33M
90	Jewel Paul	29463	2	21824.0	50J+50K
91	Inka Mechthilde Prince	29214	2	21695.0	50J+50K
92	Sir Pietertje Ormsby Mercedes	44931	36	21681.3	28I+19J+3K+17L+25M+3N+6P
93	Woodcrest Hengerveld DeKol	46514	2	21668.0	50J+50K
94	Ignaro DeKol	23538	12	21650.5	17I+17J+42K+8L+8M+8 O
95	Prince Pietertje Beryl	46977	3	21649.7	33I+33K+33M
96	Segis Pontiac Pauline Count	57188	2	21569.5	50I+50M
97	Aralia DeKol Pontiac Segis	112077	2	21560.5	50J+50K
98	Korndyke Abbekerk	34503	4	21555.3	25I+25K+25L+25M
99	King Pontiac Portia	63895	2	21525.0	50J+50K
100	DeKol 2nd's Butter Boy 3d	23260	8	21501.6	38I+13J+13K+25L+13 O
101	Beauty Pietertje Prince	56435	4	21480.3	25I+75K
102	Sir Johanna Aaggie Posch 4th	72013	2	21478.0	50J+50L
103	Madge Prince Hartog	56632	2	21438.5	100 K
104	Aaggie Cornucopia Johanna Lad	32554	3	21427.3	33I+67N
105	Pontiac Cronus	28835	4	21336.0	50J+25K+25M

Performance of the Progeny of Holstein-Friesian Sires for Milk Production.—Continued.

No.	Name	H. B. No.	No. of Daughters	Milk	Octiles
106	Dutchland Colantha Sir Inka	50999	19	21182.9	21I+21J+11K+16L+26M+5N
107	Sir Duke Walker	71158	4	21140.3	59J+25K+25N
108	King Segis Pontiac Witkop	53918	2	21124.5	59J+50L
109	Sir Paul Veeman Hengerveld	94217	7	21063.6	14I+29J+14K+14L+29M
110	Sir Forrisy DeKol Paul	40492	4	21052.8	25J+50K+25L
111	Paul DeKol 3d	22894	2	21026.0	59J+50M
112	Prince Alcartra Korndyke	88318	5	20989.6	20J+60K+20M
113	Sir Veeman Hengerveld	36158	5	20948.0	60J+40N
114	Woodcrest Tehee	74219	13	20938.4	15I+23J+23K+8L+15M+8N+8 O
115	Nieta Pauline Duke	40386	2	20934.0	50I+50N
116	Korndyke Queen DeKol's Prince	26025	9	20915.0	22I+11J+11K+22L+22M+11N
117	Joseph Prilly	51078	3	20876.0	33I+33L+33N
118	Gordon Glen Hengerveld DeKol	52410	3	20871.7	33J+67L
119	Sir Clyde	29236	2	20775.5	50J+50M
120	Emblagaard Tritomia Homestead	62924	12	20774.7	8I+33J+25K+8L+8M+17 O
121	Canary Mercedes Pietertje Hartog 6th	78123	2	20725.0	50K+50L
122	Chief of Crown Hill	39314	2	20700.0	59J+50L
123	Alcartra Polkadot Corrector	30624	13	20615.3	8I+23J+23K+23L+15M+8 O
124	Sir Daisy Mercedes DeKol (Twin)	28982	2	20587.0	50J+50M
125	Oak DeKol Ollie Homestead	85529	3	20549.0	67J+33N
126	Plum Hengerveld DeKol	27141	2	20515.0	59J+50M
127	Admiral Walker Pietertje	35269	12	20505.0	8I+25J+25K+25L+8M+8 O
128	Missouri Chief Josephine Lad	70857	4	20504.8	25I+50K+25N
129	Colantha Hartog Pietertje	96076	2	20502.5	59J+50N
130	DeKol Clothilde Artis	28340	4	20482.5	59J+25M+25N
131	Sadie Vale Concordia's Paul DeKol 3d	33661	2	20453.5	50I+50 O
132	Fayne Sir Mutual DeKol	38243	3	20439.3	33J+33L+33M
133	DeKol Creamelle Pontiac Butter Boy	48498	4	20406.5	25I+25K+25M+25 O
134	Sir Johanna Friend Clothilde	26937	3	20328.3	67K+33M
135	Juliana King of Riverside	38446	8	20325.0	13I+25J+13K+25L+13M+13 O
136	Pietje Burke	58313	4	20316.5	25J+25K+25L+25M
137	Dichter Calamity Segis DeKol	59219	2	20276.0	59J+50M
138	Wisconsin Bess Mooie DeKol	40248	2	20275.0	59J+50N
139	Mechthilde DeKol Pietertje Paul	29548	2	20251.0	59J+59M
140	Major Spofford Corona	42729	2	20241.0	50J+50M
141	Hazelwood Sir Ormsby	77572	2	20236.5	100 K
142	Sir Korndyke Hengerveld DeKol 36th	85968	3	20235.7	33K+67L
143	Sir Fayne Concordia	35227	8	20228.4	25I+13K+25M+25N+13 O
144	Ladoga King Veeman DeKol	43496	3	20169.0	33K+67L
145	Paul Rijaneta 2d	25166	3	20159.7	67K+33M
146	Paul Piehe DeKol	32059	3	20151.0	33J+33L+33M
147	Lilith Pauline DeKol's Count	28430	3	20136.7	33I+67N
148	Sir Johanna Genesra	53399	2	20104.0	50K+50L
149	Virginia Korndyke Butter Boy	128445	2	20087.0	59K+50L
150	Tirania Lady Colantha Hero	35259	2	20082.0	50K+50M
151	Prince DeHaan Butter Boy	35074	2	20029.0	59I+50 O
152	Sir Johanna DeKol 19th	64143	4	20017.5	59J+25M+25N
153	Prince Homestead DeKol	34944	6	20007.3	17J+50K+17M+17N
154	Aralia King	86837	5	20004.8	20I+20J+40M+20N
155	Rag Apple Korndyke 8th	73416	3	19978.0	33J+33M+33N
156	Sir Gerben Pietertje	40214	2	19959.5	50J+50N

Performance of the Progeny of Holstein-Friesian Sires for Milk Production.—Continued.

No.	Name	H. B. No.	No. of Daughters	Milk	Octiles
157	Lorena Korndyke	81497	2	19939.0	50K+50M
158	Sir Inka DeKol Chief	53303	5	19882.8	20J+20K+40L+20M
159	Alma Prince Jewel	32731	3	19878.3	33I+67 O
160	Cedar Lawn Sir Johanna	104092	3	19871.3	33K+67L
161	Junior DeKol (Twin)	30830	2	19861.5	50K+50L
162	Hengerveld DeKol	23102	5	19836.2	20J+20K+40L+20N
163	Mutual Paul Pietertje DeKol	35911	2	19822.0	50K+50M
164	Pabst Pontiac Champion	105106	2	19803.0	100L
165	Sir Jewel Parthenea Doede	38639	3	19798.3	33K+67L
166	King Mead of Riverside	50290	13	19754.3	15I+23J+8K+8L+8M+15N+8 O+15P
167	Tidy Abbekerk Prince	37770	5	19752.0	40I+20N+40P
168	Pontiac Korndyke	25982	7	19743.9	14I+29J+14K+14N+14 O+14P
169	Sir Urmagel Burke	58219	5	19734.6	20J+20K+20L+20M+20N
170	Christmas Pontiac King	52983	3	19709.0	67K+33N
171	Almeda Luecke 2d's Son	30266	2	19695.5	50J+50N
172	Dutchland Sir Mercena Rag Apple	51002	2	19676.0	50K+50M
173	Sir Johanna Bonheur Fayne	45671	7	19672.9	14J+29K+14L+14M+29N
174	Mutual Piebe DeKol	44554	8	19657.3	13J+25K+38L+25N
175	Sir Johanna Vernon DeKol	37499	2	19653.0	50J+50N
176	DeKol Butter Boy Prince	30369	4	19645.0	50K+25L+25M
177	Pride of Maplehurst Roe	44085	2	19636.5	100L
178	Aaggie Cornucopia 3d's Lilith	34467	5	19631.2	20K+60L+20M
179	Segis Longfield Homestead	75627	2	19606.0	100L
180	Pontiac Hesseltje Korndyke	31438	5	19562.6	40J+20K+40 O
181	Paul Hengerveld DeKol Concordia	36632	2	19553.0	50J+50N
182	Gerster 7th's Hero	35165	4	19525.0	25J+25K+25M+25N
183	King Pontiac Ruby Burke	58041	5	19513.8	20J+40K+20M+20 O
184	Beechwood Sir Josephine	26734	2	19505.0	50J+50 O
185	Duches Ormsby Butter King	30190	3	19483.3	33I+33M+33 O
186	Yakima Cornucopia	36220	3	19475.0	33J+33K+33 O
187	King Ormsby	54424	3	19470.0	67L+33M
188	Aaggie Cornucopia Pauline Count 13th	44293	10	19466.6	10J+50K+20M+10N+10P
189	Sir William Prince	37226	3	19440.0	33I+33K+33P
190	Oakland Paul Beets Burke	53309	2	19431.5	50K+50M
191	Sir Cornucopia Prince	48663	6	19428.7	17I+33J+17K+33P
192	Hengerveld Soldene Washington	107891	3	19319.7	33J+33L+33 O
193	Maplecrest Butter Boy DeKol	94156	2	19328.0	100L
194	Aaggie Cornucopia Johanna Lad Jr. 5th	60529	4	19346.5	50J+25M+25P
195	Prince Ormsby Mercedes DeKol	47008	3	19254.7	33K+33L+33M
196	Oak DeKol 2d Homestead Fobes	65750	3	19252.0	33K+33L+33N
197	Sir Pontiac Korndyke Pietertje	53618	2	19236.0	50K+50N
198	Johanna Rue Sarcastic Lad	34090	4	19235.3	25K+25L+25M+25N
199	Sir Piebe Aaggie Hengerveld	32492	10	19229.8	10I+10K+30L+20M+30N
200	Sir Challenge Diamond Beauty	57908	3	19218.0	33K+33L+33N
201	DeKol Burke	22991	8	19158.9	13I+13L+25M+38N+13 O
202	King Pontiac Netherland	50865	2	19137.5	50J+50 O
203	Greenwood Johanna Lyons	62049	2	19131.0	50K+50N
204	Korndyke Hengerveld Gerben DeKol	50361	3	19130.3	67L+33N
205	King Segis Pontiac Emperor	72287	2	19101.5	50L+50M
206	North Star Longfield Sir Beets	97403	2	19097.0	50K+50N
207	King Ormsby Parthenea	81630	5	19088.0	20K+40L+20M+20 O
208	Beauty Walker Pietertje King	84482	3	19083.0	67M+33K
209	Sir Mooie Oak DeKol	41220	3	19080.7	33J+33M+33 O

Performance of the Progeny of Holstein-Friesian Sires for Milk Production.—Continued.

No.	Name	H. B. No.	No. of Daughters	Milk	Octiles
210	Belle Korndyke Beryl Wayne	32386	2	19065.0	50L+50M
211	Arcady Segis Hengerveld Wayne	75304	4	19040.8	50K+25M+25 O
212	Sir Ybma Spofford Pledge	39074	4	19029.0	25K+50L+25M
213	Johanna Rue Lad	34989	2	19012.5	50K+50N
214	Prince Beauty Pietertje Hartog	45074	3	18978.0	33K+67M
215	St. Paul DeKol	31338	3	18948.7	33K+33M+33N
216	Sir Johanna DeKol	25467	14	18932.1	7J+14K+14L+36M +29N
217	Prince Leo Aaltje	61435	3	18921.7	33K+67M
218	Sir Pietertje Lass DeKol	94292	5	18907.2	20J+20K+20L+20M +20P
219	Lad of Home Farm	33642	2	18896.5	50L+50M
220	Sir Winana Beets Segis	52927	6	18879.3	17J+17K+17L+17M +17N+17 O
221	Sir Kaan Jewel Mercedes	43666	2	18851.0	50L+50M
222	DeKol Spofford Promise	49207	3	18816.0	67L+33M
223	Sir Piebe Johanna Sarcastic	37094	4	18808.9	25K+25L+25M+25 O
224	King Segis Hengerveld Vale	60344	8	18803.5	13J+38L+25M+13N 13 O
225	King Soldene Butterfly	91668	2	18781.5	100 M
226	Redbud Cornucopia DeKol King	93229	5	18765.6	40K+20L+20N+20 O
227	Sir Korndyke Queen	55993	9	18757.4	11J+44L+11M+11N +22 O
228	Beryl Wayne Korndyke of Riverside	32322	5	18755.6	20J+20K+20L+20 O +20P
229	Duke Spencer Lyons	45652	2	18749.0	50L+50M
230	Minnie Sandes 2d's Sir Piebe DeKol	29500	4	18731.5	50K+25M+25 O
231	Aaggie Cornucopia Pauline Count	44758	3	18712.7	33K+33L+33 O
232	Vale Mercedes 7th Posch	41416	5	18704.2	20J+40L+20M+20P
233	DeKol 2d's Paul DeKol No. 2	23366	2	18699.0	50L+50M
234	Woodcrest Pietje	35469	2	18692.0	50K+50N
235	Hengerveld DeKol Tromp	81405	3	18669.7	33L+67M
236	Gem Pietertje Paul DeKol 3d	44658	7	18655.3	29J+14K+14L+14N +14 O+14P
237	Sir Johanna DeKol Rue	33437	4	18585.8	25J+25K+25N+25 O
238	Fobes Tritomia Mutual DeKol	40534	6	18576.7	17J+17K+17M+33N +17 O
239	McKinley Hengerveld DeKol	51505	2	18525.0	100M
240	Pontiac Cornucopia	38977	2	18516.5	50L+50N
241	Johanna De Colantha Champion	60574	13	18510.2	8J+8K+31L+23M+ 15N+15P
242	Minnie Hark Prince Korndyke	41660	2	18492.0	50J+50 O
243	Creamelle Aaggie Taurus	80551	2	18432.0	50L+50M
244	Sir Johanna Aaggie Posch	38401	7	18425.6	14I+14L+43M+14N +14P
245	Sir Piebe DeKol Ringwood	31215	2	18424.5	50L+50N
246	Johanna DeKol's Lad	26938	20	18423.8	10J+10K+10L+20M+ 35N+10 O+5P
247	Johanna Pontiac DeKol	41980	5	18403.4	20K+20L+20M+20N +20P
248	Lina Clay Johanna	38214	6	18390.5	33K+17M+33N+17 O
249	Sir Johanna Korndyke	42940	8	18389.3	13J+25K+13M+25N +25 O
250	Sir Walker Segis	50672	12	18375.0	8I+8J+25K+11M+ 17N+17 O+8P
251	Dutchland Sir Pontiac Rag Apple	47282	4	18368.0	25K+25L+25M+25P
252	Pietje 22d's Woodcrest Lad	39849	2	18339.5	100M
253	Johanna Fayne Hartog	65981	2	18292.0	50K+50 O
254	Colantha 4th's Lad	26940	6	18265.8	17K+50L+33 O
255	Jewel Paul 13th	58769	3	18263.0	33K+33L+33 O
256	King Pontiac Artis	63994	3	18239.3	33L+33M+33N
257	Romeo Aaggie Acme of Riverside	32422	6	18198.8	17K+17L+17M+33N+ 17 O

Performance of the Progeny of Holstein-Friesian Sires for Milk Production.—Continued.

No.	Name	H. B. No.	No. of Daughters	Milk	Octiles
258	Prince Leila DeKol	29358	3	18192.0	33K+33M+33 O
259	Sir Korndyke Hengerveld DeKol	41266	11	18180.4	18I+9K+55N+18P
260	Sir Prilly Segis	51510	3	18144.3	67L+33 O
261	Sir Mercedes DeKol Pet	34205	2	18123.5	100M
262	Parthenea Sarcastic	42448	4	18117.5	25I+25N+50 O
263	Zady Bergsma Butter Boy	28504	3	18112.0	33L+33M+33N
264	Pontiac Hengerveld DeKol	29027	5	18083.8	20K+40L+20M+20P
265	Hollins Harlem	49795	2	18077.0	50L+50M
266	Agatha Netherland Pietertje	26980	2	18041.5	50K+50 O
267	Brom Bones	35903	4	18027.5	25K+25M+25N+25 O
268	Prex Korndyke DeKol	35900	2	18025.0	50K+50 O
269	Sir Lilith Posch	42682	3	17965.7	67L+33 O
270	DeKol 2d's Paul DeKol No. 5	25049	2	17945.0	100M
271	Johan Uilkje Lad	37852	2	17931.5	50L+50N
272	Aaggie Clothilde Bawn DeKol	33207	3	17903.0	33L+33M+33 O
273	Pearl of the Dairy's Joe DeKol	23450	9	17890.7	11J+22K+44N+11 O +11P
274	Johan Wooderest Lad	52145	5	17864.4	20K+40L+20N+20P
275	Cornelia King	86166	3	17863.7	33L+67N
276	Pontiac Hengerveld Parthenea	39972	7	17855.7	14J+14K+14M+29N +14 O+14P
277	Beryl Wayne's Son	30413	2	17805.0	50M+50N
278	Canary Mercedes Paul	29600	6	17799.7	17J+33K+17 O+33P
279	Homestead Jr. DeKol	28400	3	17779.0	33L+67N
280	Hillside Vale	41751	5	17773.8	20J+20L+20N+20 O +20P
281	Ianthe Sir Posch	33957	2	17770.5	50L+50N
282	Sir Princess Johanna	57926	2	17767.5	50L+50N
283	King Pontiac Shadeland	113938	2	17754.0	50M+50N
284	King Veeman DeKol	36819	3	17712.7	67L+33P
285	Crown Pauline Sir Hengerveld	41038	2	17695.0	50M+50N
286	Piebe Longfield DeKol	51217	4	17680.3	25L+25M+50N
287	Sir Pontiac Beets Korndyke	37200	2	17679.0	50M+50N
288	Paul Frenesta DeKol	41206	20	17668.8	10I+5J+15K+10L+ 5M+10N+15 O+30P
289	Segis DeKol Korndyke Prince	31846	2	17663.0	50L+50N
290	Jessie Fohes Tritomia Duke	32254	5	17653.0	20K+20L+20M+20 O +20P
291	Aaltje Salo Mercedes DeKol Prince	39357	8	17642.3	13K+25L+13M+25N +13 O+13P
292	Pietertje Hengerveld Mereena DeKol	42381	2	17637.0	100M
293	Sir Johanna Colantha Concordia	53059	4	17635.8	25J+25N+50 O
294	Johanna Bonheur Sir Fayne	46595	2	17617.5	50M+50N
295	Prince Ybma Spofford 6th	47135	3	17601.3	33J+33 O+33P
296	Jessie Fohes Mutual	55732	5	17582.6	20L+20M+40N+20 O
297	Carlotta 2d's Sir Parthenea	454 W. H.F.A.	2	17569.0	50M+50N
298	Spring Farm King Pontiac 8th	114319	3	17531.7	33M+67N
299	Knight Errant	39566	3	17517.3	33L+33N+33 O
300	King Segis Pontiac	44444	5	17512.0	20J+20M+60 O
301	Prince Pietertje Maid	42033	7	17504.1	14J+14K+29N+29 O +14P
302	Pontiac Zephyrus	39426	4	17502.5	25L+50M+25P
303	Count Aaggie Netherland DeKol	35887	3	17502.3	67M+33 O
304	Sir Johanna Rue DeKol	31387	2	17496.5	50L+50 O
305	Fobes DeKol Homestead	55736	2	17489.0	50M+50N
306	Norwood Veeman Hengerveld DeKol	65016	2	17440.5	50M+50N
307	Sir Beets Cornucopia Netherland	38460	4	17400.8	75M+25 O
308	Leland Sarcastic	42451	2	17391.0	50K+50P
309	Junior Concordia DeKol	35975	2	17328.5	50K+50P
310	A & G Netherland Maud Piebe DeKol	32510	2	17315.5	50J+50P

Performance of the Progeny of Holstein-Friesian Sires for Milk Production.—Continued.

No.	Name	H. B. No.	No. of Daughters	Milk	Octiles
311	Pietertje Hengerveld Segis	44781	3	17310.0	67M+33 O
312	Canary Paul	48328	6	17296.5	17L+50M+17 O+17P
313	Butter Boy Mercedes Prince	30139	2	17290.0	50L+50 O
314	King Konigen DeKol	29813	2	17287.5	50L+50 O
315	Johanna Clothilde 3d's Clyde	30550	7	17284.7	14L+14M+71N
316	Sir Henry Netherland of Hollins	30674	6	17268.0	17L+17M+33N+33 O
317	Joe Pride Aaggie DeKol	66417	2	17240.0	50K+50P
318	Hengerveld Homestead DeKol	93149	2	17221.0	50L+50 O
319	Cornucopia Hengerveld DeKol	49221	3	17182.7	33K+33N+33P
320	Judge Beets Segis	51511	2	17180.0	50M+50N
321	Sir Colantha Juliana 2d	98762	2	17174.5	50M+50 O
322	King Oak Grove	42235	4	17152.3	25K+25M+25 O+25P
323	Sir Johanna DeKol Darkness	40871	2	17119.0	50M+50 O
324	Gudultje Gerben Sir Fobes	42183	4	17115.3	25L+25M+50 O
325	Sir Ormsby Johanna DeKol	37689	2	17113.0	50L+50P
326	Sir Beets DeKol Ormsby	46763	2	17108.0	100N
327	Duke Koningen	24819	2	17080.5	50M+50N
328	Sir Pietertje Korndyke Hengerveld	74982	2	17066.0	50M+50 O
329	Sir Hengerveld DeKol Ormsby (Twin)	31211	4	16966.5	25K+25N+25 O+25P
330	Iowa Ormsby Duke	66992	2	16940.5	100N
331	Lakeside Model Alban	71013	2	16938.0	100N
332	Duke Fobes	60947	5	16923.2	20L+40N+20 O+20P
333	Sir Hubbard Pietertje	48557	2	16919.5	50K+50P
334	Sir Jolie DeKol	28633	2	16915.5	50L+50P
335	Sir DeKol Ruth	47341	2	16897.0	100N
336	Wooderest DeKol Burke	40718	2	16846.5	50L+50P
337	Mutual Friend DeKol Albrice	38079	5	16805.6	40M+20N+40 O
338	Downing Johanna Burke DeKol	84472	2	16796.0	50N+50 O
339	Elmwood Sir Hengerveld Segis	71527	2	16783.5	100N
340	DeKol Hengerveld Burke	29737	2	16755.0	50M+50 O
341	Captain Pietertje Barber	41009	2	16753.5	100N
342	Mooie Oak DeKol 2d	69278	2	16752.5	100N
343	Pietje 22d Son	58314	2	16748.5	100N
344	Star Farm Johanna Lad	45224	11	16731.8	9K+18L+27M+9N +9 O+27P
345	Gerben Boelyn	28243	2	16727.0	50M+50 O
346	Beryl Wayne DeKol Paul Pietertje	40663	2	16717.5	50M+50P
347	Homestead Masterpiece Aaggie	59682	6	16705.0	50M+17N+17 O+17P
348	Paul Mechthilde DeKol	22233	4	16703.8	25K+25L+50P
349	Sir Homestead Posch DeKol	37314	9	16618.1	11K+11L+22M+33 O +22P
350	Tulip Hengerveld DeKol	41562	3	16536.0	33L+33 O+33P
351	Sir Ormsby Hengerveld DeKol	31212	14	16533.3	7K+21L+29N+21 O +21P
352	Sir Von Harlingen Vernon DeKol	29876	2	16498.0	50N+50 O
353	Beppo Jewel Lad	30634	3	16485.0	33M+33N+33 O
354	Wit Duchess Gem	31208	2	16483.5	50N+50 O
355	Prince Inka Pietertje DeKol 2d	22699	3	16468.0	33M+67 O
356	Sir Josephine Mechthilde Pietertje	32110	2	16448.5	50P+50K
357	Star Farm Inka Count	53247	2	16430.5	50K+50P
358	DeKol Pietertje Prince 2d	27930	2	16414.5	50N+50 O
359	DeKol Paul Cornucopia King	71071	2	16404.0	50N+50 O
360	Sir Musser Clyde DeKol	40368	2	16244.5	50M+50P
361	Parkside Spofford Lyons DeKol	58022	2	16189.0	50N+50 O
362	Sir Aaggie DeKol Netherland	29588	6	16185.0	50M+50 O
363	Luecke Paul	33289	2	16072.0	50N+50 O
364	Hollywood Roselea Palmyra	121546	2	16071.0	100 O

Performance of the Progeny of Holstein-Friesian Sires for Milk Production.—Continued.

No.	Name	H. B. No.	No. of Daughters	Milk	Octiles
365	King Champion Victoria	68544	5	16060.0	20K+20L+60P
366	Sir Vale Daisy DeKol Paul	40547	2	16037.5	50N+50 O
367	Hygeia Veeman Butter Boy	43697	12	15920.4	8K+25M+17N+17 O +33P
368	Sir Ormsby DeKol	27284	2	15916.5	50N+50P
369	Clothilde Chief	20994	2	15889.0	50M+50P
370	Pietertje DeKol Paul DeKol	41895	2	15861.0	50N+50 O
371	Aaggie Sir Ormsby 2d	54901	2	15836.5	50M+50P
372	Dutchland Sir Korndyke Gladi	48121	2	15828.0	50N+50 O
373	Rag Apple Korndyke DeKol	67211	4	15772.0	25N+50 O+25P
374	Canary Piebe DeKol	35188	2	15764.5	50M+50P
375	Samuel DeKol	36903	2	15764.5	100 O
376	Lord Indi DeKol	29882	2	15753.5	50N+50P
377	Rollingdale Pauline Beets	76861	2	15732.5	50N+50 O
378	Hengerveld Butter Boy DeKol	44543	3	15728.3	33N+67 O
379	Meibloem DeKol	46593	3	15720.7	33K+33 O+33P
380	May Paul DeKol	31957	2	15693.5	100 O
381	Sir College Cornucopia	59755	2	15659.0	50N+50 O
382	Kalmuck Skylark Johanna	48832	4	15647.8	25M+50 O+25P
383	Jettine's Echo's Mercedes Prince	22499	2	15647.0	50N+50 O
384	Segis Hengerveld Johanna	76663	3	15642.3	33L+33 O+33P
385	Paul Cornucopia Mercedes Aaggie	94884	6	15619.3	17L+17N+17 O+50P
386	Sunny Jim	38883	2	15560.5	50N+50P
387	King of the Pontiacs 8th	63637	3	15558.7	100 O
388	Sir Aaltje Posch	31789	2	15557.5	50N+50P
389	Gem Segis Beets	52297	2	15553.0	50N+50 O
390	Prince Segis Johanna Korndyke	97224	2	15542.0	50N+50P
391	Johanna Colantha 2d's Sir Fayne	45998	2	15523.0	50N+50P
392	Butter Boy Hengerveld DeKol	24937	3	15520.7	33M+67P
393	Sir Carlotta Pontiac	38652	3	15501.7	33N+33 O+33P
394	Inka Jupiter Jr.	43113	2	15500.5	50M+50P
395	Korndyke Prince Grace DeKol	32655	2	15473.0	50L+50P
396	King Pontiac Dione	82595	11	15442.4	45N+18 O+36P
397	Sir Korndyke Pontiac Artis	46301	5	15411.2	40N+20 O+40P
398	King Pietertje Hengerveld Ormsby	107790	2	15376.0	50N+50P
399	Oak Grove Errant	47808	2	15317.0	50N+50P
400	Small Hopes Korndyke DeKol	32260	2	15311.5	100 O
401	Sarcastic Lad	23971	10	15256.3	10J+20N+30 O+40P
402	Woodcrest Pietje Ormsby	54909	2	15244.5	50 O+50P
403	King Prilly Pietertje	46212	2	15196.0	50N+50P
404	Sir Pontiac DeKol Burke	50920	2	15192.0	50N+50P
405	Duchess Ormsby Prince	25796	2	15096.0	50N+50P
406	Pontiac Carlotta Gerben	45807	4	15095.5	25M+25 O+50P
407	King Hengerveld Pondyke	47843	8	15079.0	13L+13N+38 O+38P
408	Sir Carlotta Pontiac Cronus	45502	4	15064.0	25L+25 O+50P
409	Sir Colantha Juliana	67203	2	15045.0	50N+50P
410	Duchess Ormsby Piebe Burke	29328	4	15023.3	25M+75P
411	Sir Lilith Pauline Johanna	52527	2	14955.0	100 O
412	Johanna DeKol's Lad 2d.	60360	2	14866.5	50L+50P
413	Sunnyside Homestead DeKol	35226	3	14811.3	67 O+33P
414	Paul Calamo Korndyke 3d	60710	2	14806.5	50 O+50P
415	Iowana Lad	70753	3	14805.0	33N+33 O+33P
416	Duke Segis Inka Korndyke	49722	7	14773.7	71 O+29P
417	North Star Johanna DeKol Duke	52163	2	14749.5	50 O+50P
418	Pontiac Arcas	41484	2	14738.5	50 O+50P
419	Wooderest Gordon Fayne	97208	4	14702.5	25N+75P
420	Paul Cornucopia America	39904	2	14700.0	50 O+50P
421	King Segis Hengerveld	51523	3	14662.3	67 O+33P
422	Butter Boy Model DeKol	37222	2	14654.0	50 O+50P
423	Plum Lad	59272	2	14559.0	50 O+50P
424	Paul Jewel DeKol Mechthilde	44916	2	14554.0	50 O+50P

Performance of the Progeny of Holstein-Friesian Sires for Milk Production.—Concluded.

No.	Name	H. B. No.	No. of Daughters	Milk	Octiles
425	Piersma Albina Segis Lad	75361	5	14528.6	20M+20 O+60P
426	Korndyke Abbekerk 3d	49288	6	14514.8	33N+17 O+50P
427	Homestead Crown Prince DeKol	25865	4	14481.3	25K+75P
428	Manor DeKol Wayne	33894	4	14368.5	25N+75P
429	The Milk & Butter King 2d	48846	2	14362.0	100P
430	Hollins Hamilton	55819	2	14350.0	50N+50P
431	Annual's Paul DeKol	26167	2	14283.5	50 O+50P
432	Lord Nudine DeKol	35639	3	14199.0	33 O+67P
433	Dan Patch Hark	37807	2	14138.5	50N+50P
434	Woodcrest DeKol Lad	45103	4	14123.8	25M+25 O+50P
435	Sir Aaggie Cornucopia Segis	76665	2	14062.0	50N+50P
436	Minnie Hark Pietertje Burke	57476	3	13862.3	33M+67P
437	Johanna Rue 2d's Paul DeKol	21724	5	13842.8	20N+20 O+60P
438	Houwtje Portage Paul DeKol	39156	2	13836.0	100P
439	Sir Korndyke Hengerveld Canary	53825	6	13816.8	17N+17 O+67P
440	Clear View Jimmy Koningen	51067	2	13816.5	50 O+50P
441	Earl Korndyke DeKol	24954	7	13722.0	14 O+86P
442	Beryl Wayne Veeman	35431	3	13698.3	33 O+67P
443	Hartog Paul Burke	49910	3	13680.0	33N+67P
444	Gilbert Pauline Paul DeKol	27796	2	13489.0	100P
445	Sir Segis Mutual Walker	80916	4	13261.3	25 O+75P
446	Parthenea's Sir Henry 2d	24091	2	13191.5	50 O+50P
447	King Lyons Spofford 3d	75034	2	13119.5	100P
448	Manor DeKol's Plum	24777	2	13006.0	100P
449	Sir Drosky Abbekerk	43075	3	12309.0	100P

There are records of the average performance of the daughters of 449 Holstein-Friesian sires contained in table 6. The average milk yield of the daughters of these sires range from 28401.7 to 13006.0 pounds. The performance of the daughters of King Hengerveld Aaggie Fayne was better than that of any other sire. This bull had three daughters with an average milk yield of 28401.7 pounds. These daughters were 67 per cent or two-thirds in the highest milking group of Holstein-Friesian cows and 33 per cent or one-third in the lowest group of milking cows.

The bull Piebe Laura Ollie Homestead King had nearly as good a record. Three daughters from this sire were tested. The average milk yield of these daughters was 28384.7 pounds and they all belonged to the highest group of milking cows.

Perhaps the honor for the most significant record belongs to the third sire, King Segis Pontiac Count. This bull had 10 daughters with an average of 28219.1 pounds of milk. These daughters were all in the highest group of milking cows. This fact is remarkable when the number of this bull's daughters are

considered. It would almost seem as if, genetically considered, this bull must be pure for the factors making for high production.

It would, of course, be of no appreciable service to the reader to continue this discussion to include each bull. There may be some interest in examining the sires' records when the milk yield of the daughters is low.

The milk yield of the daughters of Manor DeKol's Plum was the lowest of any of the sires studied. The average milk yield of his two daughters was 13006.0 pounds or less than half that the highest sire's daughters' average. All the daughters of Manor DeKol's Plum were in the P class or the lowest group.

The last four bulls are sires of daughters with quite inferior milk yields.

It will be noted that these bulls have only two daughters and that these daughters are all in the P class or lowest group. No bull with more than this number of daughters appears to have all of the daughters in the P class or lowest group.

The inquiry may now be made as to how many of the 449 sires have daughters which are significantly superior or which are significantly inferior to the average of the Holstein-Friesian breed. This inquiry may only be answered by a consideration of the probable errors of the determinations for milk yield as given in table 5.

If it be considered that the records over three times this probable error are significantly higher or lower than the mean or average of all advanced registry cows then it is possible to determine those bulls which are so significantly differentiated from the others as pertains to the milk yield of their daughters.

When so defined it is found that the mean milk yield of the following sires' daughters is significantly higher than the average of the other sires that have daughters in the advanced registry. The number of the sire in table 6 is given at the left of the sire's name. At the right of the sire's name is given the significance to be attached to the milk record of his daughter. Significant is to be considered as indicating that there is probably a real difference between the milk yield of the given sire's daughters and the average milk yield of all the daughters. Quite significant indicates a difference which is more significant than the former division, significant. In other words this indicates

that these sires will probably have more high testing daughters than will those sires who are just marked significant. Those sires recorded as markedly significant have an even greater chance of having high milk producing daughters than those sires recorded as quite significant.

1	King Hengerveld Aaggie Fayne	Quite significant
2	Piebe Laura Ollie Homestead King	Quite significant
3	King Segis Pontiac Count	Markedly significant
4	Cornucopia Pontiac Johanna Lad	Significant
5	King Segis Beets	Significant
6	Duke Ormsby DeKol Creamelle	Significant
7	King Palmyra Fayne	Significant
8	Cornucopia Waukasha Prince	Significant
9	White Segis DeKol	Significant
10	Colantha Johanna Champion	Significant
11	Linden Butter Boy Pietertje	Significant
12	Wachusett Creamelle George	Significant
13	Iowana Sir Ollie	Significant
14	Masterpiece	Significant
15	Wit Segis Abbekerk	Significant
16	Spring Farm King Pontiac 6th	Significant
17	Sir Korndyke Bess	Significant
18	Sir Johanna Butter Fayne	Significant
19	Johanna McKinley Segis	Significant
20	Ormsby Korndyke Lad	Significant
21	Count King	Significant
22	Friend Hengerveld DeKol Butter Boy	Significant
23	Emblagaard Prince	Significant
24	Sir Jolie Johanna	Significant
25	The Milk and Butter King	Significant
26	Johanna Bonheur Champion	Significant
28	Dutchland Sir Pietertje Hengerveld	Significant
31	Sir Concordia Korndyke	Significant
32	Colantha Johanna Lad	Quite significant
36	Sir Ormsby Skylark	Significant
37	Pietertje Hengerveld Sir Korndyke	Quite significant
38	Aaggie 3d's Wayne's Paul DeKol	Significant
39	Sir Longfield DeKol	Significant
40	King Walker	Significant
43	Segis Pontiac DeKol Burke	Significant
47	Aaggie Cornucopia Johanna Lad Jr.	Significant
52	Homestead Girl DeKol Sarcastic Lad	Quite significant
55	Johanna Rue 3d's Lad	Significant
57	Piebe Champion	Significant
59	Quirinus Cornucopia	Significant
63	Pontiac Aaggie Korndyke	Quite significant

66	King Pontiac Champion	Quite significant
68	Sir Johanna Piebe	Significant
69	Johanna Colantha Sarcastic Lad	Significant
77	Sir Johanna Fayne	Significant
80	King of the Pontiacs	Quite significant
88	Sir Hengerveld Model Johanna	Significant
92	Sir Ormsby Mercedes	Quite significant

Without much doubt the sire in this list whose daughters had the most significant difference in their milk yield from the average of the breed is King Segis Pontiac Count. His daughters are in fact so consistant in their behavior as to make his pedigree of some interest. This pedigree for four generations is given below. The figures beside the name of the bulls represent what their tested daughters did as milk producers and as butter-fat testers. The figure in the circle gives the number of daughters. The figures beside the names of the cows give the corrected 365 day milk yield and butter-fat percentage of such cows.

Pedigree of King Segis Pontiac Count 93909

Maine Agr. Exp. Sta.—Standard Pedigree Blank

Sheet No.

No. 93909 King Segis Pontiac Count 3.458
28219.1
Sex ♂ (10)

No. 110228 K.P. Lilith Clothilde 25923 3.75
♀

No. 44444 King Segis Pontiac 17512.0 3.444 (5)
♂

No. 36168 ♂ (1)
King Segis
15127 3.22

No. 69991 ♀
Pontiac Clothilde
DeKol 2d
25815 4.02

No. 39037 ♂ (37)
King
Pontiacs
22182.7 3.774

No. 78841 ♀
No rec.
Lilith Clothilde
Boon

No. 29830 No rec. ♂
Mercedes Julip's
Pietertje Paul

No. 55163 No rec. ♀
A & G. Inka
McKinley

No. 25982 ♂
Pontiac Korndyke
19743.9 3.623 (7)

No. 49657 No rec. ♀
Pontiac Clothilde
DeKol

No. 25982 ♂ ⊕
Pontiac Korndyke
19743.9 3.623 (7)

No. 51585 No rec. ♀
Pontiac Lunde
Hengerveld

No. 28430 (3) ♂
Lilith Pauline
DeKol's Count
20136.7 3.490

No. 61391 No rec. ♀
Clothilde Pietertje
Boon

No. 21724 13842.8 3.152 (5) ♂
Johanna Rue 2d's Paul DeKol

No. 39480 No rec. ♀
Mercedes Julips Pietertje

No. 23378 No rec. ♂
Billy McKinley

No. 36617 No rec. ♀
Segis Inka

No. 22779 No rec. ♂
Manor Josephine DeKol

No. 13913 No rec. ♀
Belle Korndyke

No. 23102 19836.2 3.674 ♂
Hengerveld DeKol (5)

No. 34741 No rec. ♀
Rag Apple's Clothilde Artis

No. 23102 ♂ ⊕
Hengerveld DeKol

No. 34745 No rec. ♀
Lunde Beauty

No. 22909 No rec. ♂
Pauline Paul 2d's Count

No. 43434 No rec. ♀
Lilith Pauline DeKol

No. 27349 No rec. ♂
Lamb DeKol Pietertje Boon

No. 39025 No rec. ♀
Maggie Lamb

It will be noted that the sire of King Segis Pontiac Count had 5 daughters with an average milk yield of 17512.0 pounds. Such a bull could not be considered more than a mediocre animal. The dam of King Segis Pontiac Count was an excellent animal with a milk production of the first class. The milk yield of the grandsire's daughters was poor for the one recorded daughter of King Segis and good for the daughters of King of the Pontiacs. One of the granddams had a very excellent milk yield, the other had no year record. It will be noted that this bull is inbred to Pontiac Korndyke and Hengerveld DeKol.

The bulls whose daughters are significantly lower in their average milk yield than the average advanced registry cow's milk yield of the Holstein-Friesian breed may now be examined. The bulls to have their daughters' average milk yield significantly lower than that of the average milk yield of the advanced registry must be at least 3 times the probable error (as tabled in table 5) lower than this average yield, 19288.6. The list below gives those sires which have daughters with an average milk yield less than the average of the advanced registry cows. The number given first is the number of table 6. The name of the sire is followd by a statement of the significance to be attached to its record.

449	Sir Drosky Abbekerk	Significant
448	Manor DeKol's Plum	Significant
447	King Lyons Spofford 3d	Significant
446	Parthenea's Sir Henry 2d	Significant
445	Sir Segis Mutual Walker	Significant
443	Hartog Paul Burke	Significant
442	Beryl Wayne Veeman	Significant
441	Earl Korndyke DeKol	Significant
439	Sir Korndyke Hengerveld Canary	Significant
437	Johanna Rue 2d's Paul DeKol	Significant
436	Minnie Hark Pietertje Burke	Significant
434	Woodcrest DeKol Lad	Significant
432	Lord Nudine DeKol	Significant
428	Manor DeKol Wayne	Significant
427	Homestead Crown Prince DeKol	Significant
426	Korndyke Abbekerk 3d	Significant
425	Piersma Albina Segis Lad	Significant
419	Woodcrest Gordon Fayne	Significant
416	Duke Segis Inka Korndyke	Significant
410	Duchess Ormsby Piebe Burke	Significant
408	Sir Carlotta Pontiac Cronus	Significant

407	King Hengerveld Pondyke	Significant
401	Sarcastic Lad	Significant
397	Sir Korndyke Pontiac Artis	Significant
396	King Pontiac Dione	Significant
385	Paul Cornucopia Mercedes Aaggie	Significant
367	Hygeia Veeman Butter Boy	Significant
351	Sir Ormsby Hengerveld DeKol	Significant
344	Star Farm Johanna Lad	Significant

In this list it will be noted no sire's daughters' milk yields are more than significantly below the average of the Holstein-Friesian breed. This is very encouraging to those interested in the breed's progress.

Not so encouraging is the fact that out of a total of 449 sires only 48 are siring daughters who are on the average significantly higher than those of the advanced registry cows. This would make it seem that unless more of these sires can be bred the breed is going to stand still.

These two lists, the first representing the better sires and the second the inferior sires, as measured by their daughters' average milk production, furnish data of value in assisting to solve some of the mooted questions of the dairying practice. From the pedigrees of these animals we should be able to determine the surpassing value or deleterious effect of inbreeding in the production of the superior or inferior sire for transmitting milk yield. We should be able to go further and determine if kinship between the sire and dam of a bull is meritorious or harmful; in other words whether breeding within families is today a practice of real or doubtful worth.

Four generation pedigrees have been made for each of these bulls. The amount of inbreeding has been determined for each of the pedigreed bulls for these four generations. For these studies the inbreeding is defined as the condition or state in which the animal in question has fewer different ancestors than the maximum number possible or put in another way, that the ancestors are repeated in the pedigree. The degree or amount of this inbreeding as determined for each generation is recorded as Z_1, Z_2, Z_3 for the second, third and fourth generations of the pedigree. These coefficients are shown in the following tables 7 and 8. Besides these coefficients for the individual generations there is another coefficient which determines as a single numerical quantity the amount of inbreeding which exists in the

pedigree of a given animal when referred to the maximum possible amount of inbreeding for the brother and sister mating. This value is called ZT_3 and appears in the same tables. A relationship between the sire and the dam of a given animal may be said to exist when these animals have one or more common ancestors. The closeness of the relationship is, in general, proportional to the number of different ancestors which the two individuals have in common, out of the whole number they might possibly have in common. The numerical intensity of this relationship is expressed as percentage of the total amount possible. This information is shown for each generation as K_2, K_3 and K_4 for the second, third and fourth generations respectively. Table 7 gives information for the sires whose daughters' average milk yield was significantly higher than the rest of the breed. Table 8 gives the information for those sires whose daughters' milk yield was significantly lower than the rest of the breed.

There are 48 sires included in table 7. Of this number 2 were inbred in the second ancestral generation, 10 in the third ancestral generation and 30 in the fourth ancestral generation. Two sires had their sire and dam related in the second generation, 8 sires had their sire and dam related in the third generation, and 19 had their sire and dam related in the fourth generation. Reduced to a percentage these sires displayed 4.1 per cent in the second generation; 20.8 per cent in the third generation; and 62.5 in the fourth generation of their number inbred to some degree. In the same manner 4.1 per cent in the second generation; 16.7 per cent in the third generation and 39.6 per cent in the fourth generation displayed some relationship between their sire and dam.

The greatest amount of inbreeding was shown in the pedigree of the sire, King Walker, whose grandsire, Admiral Walker, appeared in both sides of the pedigree and whose great grand dam, Lillian Walker, on the sire's side, appeared also, as a great-great-grand-dam on the dam's side of the pedigree.

The mean amount of inbreeding for each generation is on the whole rather small, amounting to only 8.74 per cent on the average for the fourth generation or 6.52 per cent of the total possible amount if brother and sister matings were practiced throughout. The amount of relationship between the sire and dam of each bull for the whole group of 48 sires is rather small

since the average of the total possible amount of relationship, up to and including the fourth generation is only 10.41 per cent.

TABLE 7.

Ancestral Analysis of the Pedigrees of the Bulls which Sired Significantly High Milking Daughters

No.	Name of Sire	Registry No.	Z_1	Z_2	Z_3	Z_{T3}	K_2	K_3	K_4
1	King Hengerveld Aaggie Fayne	56635	0	0	0	0	0	0	0
2	Piebe Laura Ollie Homestead King	110474	0	12.5	25.0	17.7	0	25.0	50.0
3	King Segis Pontiac Count	93909	0	12.5	18.8	14.7	0	25.0	37.5
4	Cornucopia Pontiac Johanna Lad	48355	0	0	0	0	0	0	0
5	King Segis Beets	48702	0	0	0	0	0	0	0
6	Duke Ormsby DeKol Creamelle	63578	0	0	6.3	3.0	0	0	0
7	King Palmyra Fayne	72099	0	0	0	0	0	0	0
8	Cornucopia Waukasha Prince	35119	0	0	18.8	8.8	0	0	25.0
9	White Segis DeKol	78027	0	0	0	0	0	0	0
10	Colantha Johanna Champion	45674	0	0	12.5	5.9	0	0	0
11	Linden Butter Boy Pietertje	54120	25.0	25.0	25.0	50.0	50.0	50.0	50.0
12	Wachusett Creamelle George	41803	0	12.5	18.8	14.7	0	0	12.5
13	Iowana Sir Ollie	114797	0	0	6.3	3.0	0	0	0
14	Masterpiece	84099	0	0	6.3	3.0	0	0	0
15	Wit Segis Abbekerk	85556	0	0	0	0	0	0	0
16	Spring Farm King Pontiac 6th	103899	0	12.5	12.5	10.0	0	25.0	25.0
17	Sir Korndyke Bess	110157	0	0	6.3	3.0	0	0	12.5
18	Sir Johanna Ruth Fayne	53055	0	0	18.8	8.8	0	0	12.5
19	Johanna McKinley Segis	44367	0	0	12.5	5.9	0	0	12.5
20	Ormsby Korndyke Lad	102469	0	0	0	0	0	0	0
21	Count King	59660	0	12.5	12.5	10.0	0	0	0
22	Friend Hengerveld DeKol Butter Boy	29303	0	12.5	25.0	17.7	0	25.0	37.5
23	Emblagaard Prince	83596	0	0	0	0	0	0	0
24	Sir Jolie Johanna	36664	0	0	18.8	8.8	0	0	0
25	The Milk and Butter King	41114	0	0	0	0	0	0	0
26	Johanna Bonheur Champion	94984	0	0	6.3	3.0	0	0	12.5
28	Dutchland Sir Pietertje Hengerveld	48696	0	0	6.3	3.0	0	0	0
31	Sir Concordia Korndyke	75012	0	0	6.3	3.0	0	0	12.5
32	Colantha Johanna Lad	32481	0	0	6.3	3.0	0	0	0
36	Sir Ormsby Skylark	47010	0	0	6.3	3.0	0	0	12.5
37	Pietertje Hengerveld Sir Korndyke	60966	0	0	12.5	5.9	0	0	12.5
38	Aaggie 3d's Wayne's Paul DeKol	27868	0	0	0	0	0	0	0
39	Sir Longfield DeKol	36380	0	12.5	25.0	17.7	0	25.0	50.0
40	King Walker	40358	25.0	25.0	31.3	50.0	50.0	50.0	62.5
43	Segis Pontiac DeKol Burke	97472	0	0	12.5	5.9	0	0	0
47	Aaggie Cornucopia Johanna Lad Jr.	36974	0	12.5	12.5	10.0	0	25.0	25.0
52	Homestead Girl DeKol Sarcastic Lad	32558	0	0	0	0	0	0	0
55	Johanna Rue 3d's Lad	26939	0	0	0	0	0	0	0
57	Piebe Champion	60577	0	0	12.5	5.9	0	0	12.5
59	Quirinus Cornucopia	60751	0	0	6.3	3.0	0	0	0
63	Pontiac Aaggie Korndyke	38291	0	0	0	0	0	0	0
66	King Pontiac Champion	53418	0	0	0	0	0	0	0
68	Sir Johanna Piebe	53257	0	0	12.5	5.9	0	0	12.5
69	Johanna Colantha Sarcastic Lad	38402	0	0	6.3	3.0	0	0	0
77	Sir Johanna Fayne	42147	0	0	12.5	5.9	0	0	12.5
80	King of the Pontiacs	39037	0	0	0	0	0	0	0
88	Sir Hengerveld Model Johanna	40338	0	0	0	0	0	0	0
92	Sir Pietertje Ormsby Mercedes	44931	0	0	0	0	0	0	0
	Mean		1.04	3.12	8.74	6.52	2.08	5.21	10.41

Of the individual sires, King Walker, Piebe Laura Ollie Homestead King, Linden Butter Boy Pietertje and Sir Longfield DeKol, all have 50 per cent or over of the greatest possible relationship between their sires and dams, up to and including the fourth generation.

Table 8 shows the pedigree analysis for those sires whose daughters were significantly lower in their milk yield than the rest of the breed.

TABLE 8.

Ancestral Analysis of the Pedigrees of the Bulls Which Sired Significantly Low Milking Daughters.

No.	Name of Sire	Registry No.	Z_1	Z_2	Z_3	ZT_3	K_2	K_3	K_4
449	Sir Drosky Abbekerk	43075	0	0	0	0	0	0	0
448	Manor DeKol's Plum	24777	0	0	6.3	3.0	0	0	0
447	King Lyons Spofford 3d	75034	0	12.5	12.5	10.0	0	25.0	25.0
446	Parthenea's Sir Henry 2d	24091	0	0	0	0	0	0	0
445	Sir Segis Mutual Walker	80916	0	0	6.3	3.0	0	0	0
443	Hartog Paul Burke	49910	0	0	6.3	3.0	0	0	0
442	Beryl Wayne Veeman	35431	0	0	0	0	0	0	0
441	Earl Korndyke DeKol	24954	0	0	0	0	0	0	0
439	Sir Korndyke Hengerveld Canary	53825	0	0	0	0	0	0	0
437	Johanna Rue 2d's Paul DeKol	21724	0	0	0	0	0	0	0
436	Minnie Hark Pietertje Burke	57476	0	0	0	0	0	0	0
434	Wooderest DeKol Lad	45103	0	0	0	0	0	0	0
432	Lord Nudine DeKol	35639	0	0.	6.3	3.0	0	0	0
428	Manor DeKol Wayne	33894	0	0	12.5	5.9	0	0	0
427	Homestead Crown Prince DeKol	25865	0	12.5	12.5	10.0	0	25.0	25.0
426	Korndyke Abbekerk 3d	49288	0	0	0	0	0	0	0
425	Piersma Albina Segis Lad	75361	0	0	0	0	0	0	0
419	Wooderest Gordon Fayne	97208	0	0	0	0	0	0	0
416	Duke Segis Inka Korndyke	49722	0	0	12.5	5.9	0	0	12.5
410	Duchess Ormsby Piebe Burke	29328	0	0	6.3	3.0	0	0	12.5
408	Sir Carlotta Pontiac Cronus	45502	0	0	0	0	0	0	0
407	King Hengerveld Pondyke	47843	0	0	0	0	0	0	0
401	Sarcastic Lad	23971	0	0	6.3	3.0	0	0	0
397	Sir Korndyke Pontiac Artis	46301	0	12.5	25.0	17.7	0	0	25.0
396	King Pontiac Dione	82505	0	0	6.3	3.0	0	0	12.5
385	Paul Cornucopia Mercedes Aaggie	94884	0	0	12.5	5.9	0	0	12.5
367	Hygeia Veeman Butter Boy	43697	0	0	6.3	3.0	0	0	0
351	Sir Ormsby Hengerveld DeKol	31212	0	0	6.3	3.0	0	0	0
344	Star Farm Johanna Lad	45224	0	0	12.5	5.9	0	0	12.5
	Mean		0.0	1.29	5.40	3.04	0.0	1.72	4.74

There are 29 sires included in table 8, of these no sire showed any inbreeding in the second generation, 3 showed some inbreeding up to and including the third generation and 16 showed some inbreeding up to and including the fourth generation. No sire had related sires and dams up to the third generation, only 2 had related sires and dams up to the fourth gen-

eration and 8 had related sires and dams up to the fifth generation. If these figures are reduced to a percentage basis it is found that (1), there is no inbreeding up to third generation, (2), there are 10.4 per cent of the sires which show inbreeding in the third generation, (3), there are 55.2 per cent of the sires which show inbreeding up to the fifth generation.

The percentage of sires, which have their sire and dam related, is (1) zero up to the third generation, (2) 7.0 per cent up to the fourth generation and (3) 27.5 per cent up to the fifth generation.

These data in conjunction with those of table 7 furnish some of the necessary information to determine whether inbreeding is a valuable or harmful practice when applied to dairy animals. The percentage of sires which were inbred for the group of sires having daughters of high milk yield as against those who had daughters of low milk yield is indicated below.

Sires with daughters of high milk yield had:

4.1 per cent of their number inbred in the second generation.
20.8 per cent of their number inbred in the third generation.
64.5 per cent of their number inbred in the fourth generation.

Sires with daughters of low milk yield had:

0.0 per cent of their number inbred in the second generation.
10.4 per cent of their number inbred in the third generation.
55.2 per cent of their number inbred in the fourth generation.

The sires with the higher milk producing daughters are consequently somewhat more frequently inbred than are the sires of the daughters with a relatively low milk yield.

For those sires whose daughters are low producers the amount of inbreeding for each sire's pedigree ranges from 0 to 25 per cent of the total possible amount, up to and including the fourth generation. The average amount of inbreeding is 5.40 per cent for all the sires. Comparing this average inbreeding (5.40 per cent) with that of the sires whose daughters are high milk producers (8.74 per cent) it is seen that the sires with the most desirable daughters are most inbred. This statement is further corroborated by the coefficients showing the total amount of inbreeding as compared with the greatest possible amount of the brother and sister mating, Z_{T_3}. The total amount of in-

breeding for those sires who have superior milking daughters is 6.52. For those sires who have inferior milking daughters the total amount of inbreeding is 3.04 or the most desirable sires are nearly twice as much inbred as the least desirable sires.

East and Hayes[8] have pointed out that an animal may be inbred quite intensely and yet have his sire and dam in no way related. Clearly such being the case it is highly probable that such an animal might have every chance of carrying a mixed or heterozygous germinal constitution, and would be very unlikely to suffer any effects of inbreeding. It is necessary, therefore, to examine the amount of relationship between the sire and dam of the bull in conjunction with the inbreeding coefficient to determine what the complete effect of inbreeding has been.

Examination of these pedigrees showed that the sires whose daughters were high milk producers had a higher amount of relationship between their sires and dams than those sires whose daughters produced an inferior amount of milk. The average amount of this relationship for the sires with superior milking daughters was:

2.08 per cent in the second generation.
5.21 per cent in the third generation.
10.41 per cent in the fourth generation.

The average amount of this relationship for those sires with poorer milking daughters was:

0.0 per cent in the second generation.
1.72 per cent in the third generation.
4.74 per cent in the fourth generation.

The facts on inbreeding and relationship as derived from the study of the pedgirees of the sires whose daughters' milk yield is large compared with the rest of the breed in contrast to the study of the pedigrees of the sires whose daughters' milk yield is small compared with the rest of the breed, shows that contrary to the general belief the inbreeding is greater in the pedigrees of the sires of the highest producing daughters than

[8]East, E. M. and Hayes, H. K.
1912. Heterozygosis in Evolution and in Plant Breeding.
U. S. Dept. Agr. Bur. Plant Industry, Bul. No. 243, pp. 1-58, 1912.

it is in the pedigrees of the sires of the lowest producing daughters. The study of these same groups of sires to show the amount of relationship or the number of ancestors on the sire's side of the pedigree which are repeated on the dam's side of the pedigree, shows that the sires of the high milking daughters have their sires and dams more related than do the sires of the low milking daughters.

Too much stress should not be laid on this conclusion for as will be shown in the succeeding section, the inbreeding and relationship of a random sample of the Holstein-Friesian sires, without advanced registry records, are the same as that shown for the sires of the high milking daughters within the limits of random sampling. Further if we compare the differences of these inbreeding and relationship coefficients for the two groups with the probable errors as calculated from the standard deviations given on page 138 we find that the differences are in general less than 2 times the probable error. Such being the case the difference in the inbreeding and relationship within the pedigrees of the sires of high milk producing daughters and the pedigrees of the low milking daughters is probably not significant.

INBREEDING AND RELATIONSHIP SHOWN IN THE PEDIGREES OF HOLSTEIN-FRIESIAN SIRES WITHOUT ADVANCED REGISTRY RECORDS

For this purpose 33 bulls without advanced registry daughters were chosen and pedigreed. These bulls were chosen at random save for the fact that they were to include the same relative number in each of the ten thousand Herd Book numbers as were included in the list of sires pedigreed for the previous study on milk yield and for the succeeding study on butterfat percentage. Table 9 shows the list of these sires.

TABLE 9.

Random Sample of Sires Selected for Pedigree Analysis

Name	Herd Book No.
Hillview Josie's King Echo	21327
Ducat Lutscke	25120
Highlawn Pietertje Prince	25642
Togus DeKol Prince	28931
Maple Farm George	32257
Paul Aaggie Jewel DeKol 5th	33425
King Mechthilde DeKol Paul	35587
Duke Thyrsa DeKol	38731
Victor Ormsby	39126
Count Cradock DeKol Colantha	39286
Duke DeKol of Richmond	41237
Dewey Monarch DeKol	43254
Duke Clothilde Mercedes	43424
Spofford Corona DeKol	45120
Dio Judge	45588
Oregon Regis DeKol	45641
Royalton DeKol Count	48931
Ruby Sir Posch Johanna	49125
Korndyke Colanthus	49285
Uther Brookside Pietj DeKol	51057
Prince of Brecon	52062
King Fairfax DeKol Mercedes	56149
Duke Monarch	59668
King Nellie Prince Shadeland 2d	65460
Vale Cradock DeKol 3d	66511
Sir Mutual Pride DeKol Jr.	70839
Sunflower Sir Mutual	78654
Beets DeKol Prince	85914
Maple Crest DeKol Beauty Boy	87983
Prince Pontiac DeKol Butter Boy	90312
Abbekerk Mercena DeKol	92464
Empire Fame	103401
Jewel Mohee Bush	113459

The inbreeding and relationship coefficients for the four generation pedigrees of these sires is shown in Table 10.

TABLE 10.

Inbreeding and Relationship Shown by Holstein-Friesian Sires Without Advanced Registry Daughters

Name	Registry No.	Z_1	Z_2	Z_3	Z_{T3}	K_2	K_3	K_4
Hillview Josie's King Echo	21327	0	0	6.3	3.0	0	0	0
Ducat Lutscke	25120	0	12.5	18.8	14.7	0	25.0	37.5
Highlawn Pietertje Prince	25642	25.0	25.0	25.0	50.0	50.0	50.0	50.0
Togus DeKol Prince	28931	0	0	0	0	0	0	0
Maple Farm George	33257	25.0	25.0	31.3	50.0	50.0	50.0	62.5
Paul Aaggie Jewel DeKol 5th	33425	0	12.5	12.5	10.0	0	25.0	25.0
King Mechthilde DeKol Paul	35587	0	0	0	0	0	0	0
Duke Thyrsa DeKol	38731	0	12.5	12.5	10.0	0	0	0
Victor Ormsby	39126	0	0	6.3	3.0	0	0	12.5
Count Cradock DeKol Colantha	39286	0	0	0	0	0	0	0
Duke DeKol of Richmond	41237	0	0	0	0	0	0	0
Dewey Monarch DeKol	43254	0	0	0	0	0	0	0
Duke Clothilde Mercedes	43424	0	25.0	31.3	26.5	0	25.0	25.0
Spofford Corona DeKol	45120	0	0	0	0	0	0	0
Dio Judge	45588	0	12.5	18.8	14.7	0	0	0
Oregon Regis DeKol	45641	0	12.5	12.5	10.0	0	0	0
Royalton DeKol Count	48931	0	0	0	0	0	0	0
Ruby Sir Posch Johanna	49125	0	0	0	0	0	0	0
Korndyke Colanthus	49285	0	0	0	0	0	0	0
Uther Brookside Pietj DeKol	51057	0	0	0	0	0	0	0
Prince of Brecon	52062	0	12.5	25.0	17.7	0	0	0
King Fairfax DeKol Mercedes	56149	0	0	0	0	0	0	0
Duke Monarch	59668	0	12.5	12.5	10.0	0	0	0
King Nellie Prince Shadeland 2d	65460	0	0	0	0	0	0	0
Vale Cradock DeKol 3d	66511	0	0	0	0	0	0	0
Sir Mutual Pride DeKol Jr.	70839	0	0	0	0	0	0	0
Sunflower Sir Mutual	78654	0	0	6.3	3.0	0	0	0
Beets DeKol Prince	85914	0	0	0	0	0	0	0
Maple Crest DeKol Beauty Boy	87983	25.0	25.0	31.3	50.0	50.0	50.0	50.0
Prince Pontiac DeKol Butter Boy	90312	0	0	6.3	3.0	0	0	12.5
Abbekerk Mercena DeKol	92464	0	0	6.3	3.0	0	0	0
Empire Fame	103491	0	25.0	50.0	35.3	0	25.0	50.0
Jewel Mohee Bush	113459	0	12.5	12.5	10.0	0	0	0
Mean		2.27	6.82	9.86	9.82	4.54	7.58	9.85

Within this pedigree group there are

3 or 9.1 per cent show inbreeding in the second generation.
13 or 39.4 per cent show inbreeding in the third generation.
18 or 54.5 per cent show inbreeding in the fourth generation.

By comparing these percentages with those of the sires of high milk producing daughters it will be noted that the random sample sires have more of their number inbred in the second and third generations than do the advanced registry sires. In the fourth generation the number inbred is slightly less than the advanced registry group.

The number of sires who have sire and dam related are

3 or 9.1 per cent in the second generation.
7 or 21.2 per cent in the third generation.
9 or 27.2 per cent in the fourth generation.

Comparing these results with those for the advanced registry sires, the random sample group of sires show a greater kinship between their sires and dams, for the second and third generations, and a slightly smaller relationship for the fourth generation, than is shown by the advanced registry sires.

The actual amount of inbreeding for the random sample group is somewhat more than it is for either advanced registry group. It is, however, probably not significantly greater than the sires of high milking daughters or the sires of low milking daughters for each generation.

The kinship for this random sample group is greater than either of the advanced registry groups for the second and third generations. For the fourth generation the kinship for the sires of high milking daughters is slightly greater than is the kinship for the random sample sires. The differences are not significant.

The results for the three groups of Holstein-Friesian sires' pedigrees indicate that as normally practiced there need be little fear of inbreeding proving detrimental to the herd.

ANIMALS APPEARING IN THE PEDIGREES OF THE SIRES WHICH HAVE DAUGHTERS WITH A SIGNIFICANTLY HIGH MILK YIELD

The principle contained in the saying "like begets like" is reflected in the breeding operations of most dairymen. It is reflected at the auction block where the auctioneer's chief argument for the purchase of an animal may be that the animal on sale had *Prince Illustrious* or *Lady High Producer* appear in the fourth generation of its pedigree.

Studies in heredity on such things as flies and caterpillars have shown us that the principle of "like begets like" is only a partial truth. To date scarcely any test of its true worth has been made on animals of economic importance. The sires whose daughters were significantly higher in their milk yield than the rest of the breed in contrast to those sires whose daughters' milk yields were significantly lower than the rest of the breed constitute good material to test further the value of this saying as a guide to dairy practice.

Should the saying be true it would be expected that the animals of a given group most repeated in a generation would produce the greatest impression on the group. In other words the animals repeated most frequently in the pedigrees of the sires with high producing daughters would be expected to have transmitted most of the high production and would, in fact, be expected to carry high production in their germ plasm. The animals which are repeated in the pedigrees of the sires whose daughters were low producers would for the same reason be expected to carry the low producing factors. Now if these hypotheses which follow from this saying "like begets like" are true it would follow that the animals repeated in the high producing group should not be repeated in the low producing group. The corollary should also be true that the animals repeated in the pedigrees of the low producing sires should not be repeated in the high producing group. This furnishes the desired test for this much used principle.

The four generation pedigrees which were used for the study of the inbreeding and relationship were analyzed for the different animals contained therein. The animals repeated in any groups appear in the proper generation in the table for that group.

Table 11 contains the numbers of all repeated animals which appear in the group of sires whose daughters were significantly high milk producers. This information is classified into the generation in which the animal appeared, whether it was on the sire's side or on the dam's side of the pedigree and into males or females. The number of times the animal appears is given after the name.

TABLE 11.

Animals repeated in the pedigrees of sires whose daughters were significantly high or low milk producers or high or low in their butter-fat percentage. This table is for those sires whose daughters were significantly high in their milk yield.

Sire's Side of Pedigree Name	H.B. No.	No. of Appearances	Dam's Side of Pedigree Name	H.B. No.	No. of Appearances
FIRST GENERATION Males			FIRST GENERATION Females		
Sarcastic Lad	23971	3	Colantha 4th's Johanna	48577	2
Sir Fayne Concordia	35227	3	Piebe Longfield Night	75749	2
King Fayne Segis	46767	3			
Pontiac Korndyke	25982	2			
Aaggie Cornucopia Johanna Lad	32554	2			
King Segis	36168	2			
King of the Pontiacs	39037	2			
Colantha Johanna Champion	45674	2			
Males appearing once for which only herd book number need be given. 22894, 23102, 23224, 23260, 26533, 26935, 26936, 28660, 29642, 31212, 35077, 35269, 44444.			Females appearing once for which only herd book number need be given. 35164, 37842, 39480, 42167, 48423, 51585, 52256, 64169, 71767, 78051, 87805		
SECOND GENERATION Males			SECOND GENERATION Males		
King Segis	36168	5	Hengerveld DeKol	23102	4
Maurice Bonheur	22394	3	Paul Beets DeKol	22235	2
Homestead Jr. DeKol	28400	3	Sir Johanna	23446	2
DeKol 2d's Butter Boy	21366	2	Paul Colantha	23447	2
Manor Josephine DeKol	22779	2	Sarcastic Lad	23971	2
DeKol 2d's Butter Boy 3d	23260	2	Almeda Luecke 2d's Piebe DeKol	28660	2
Sarcastic Lad	23971	2			
Pontiac Korndyke	25982	2			
Johanna Aaggie Sarcastic Lad	26935	2			
Mercedes Julips Pietertje's Paul	29830	2			
Sir Fayne Concordia	35227	2			
Sir Korndyke Hengerveld DeKol	41266	2			
Males appearing once for which only herd book number need be given. 14634, 21226, 22909, 23300, 25755, 25795, 25865, 26239, 28133, 32554, 35269, 38835, 39037, 44444			Males appearing once for which only herd book number need be given. 18508, 18726, 19856, 20735, 20854, 22894, 22991, 23200, 23224, 23260, 23366, 25467, 25700, 25755, 26533, 26939, 27945, 28176, 29302, 31212, 32554, 36168, 39037		

Females		
Belle Sarcastic	23039	3
Grace Fayne 2d	44124	3
Aaggie Cornucopia Pauline	48426	3
Grace Fayne 2d's Homestead	68828	3
Belle Korndyke	13913	2
Colantha 4th's Johanna	48577	2
Pontiac Lunde Hengerveld	51585	2
A & G. Inka McKinley	55163	2
Females appearing once for which only herd book number need be given, 734, 24137, 26731, 29237, 32259, 35439, 36477, 40962, 42168, 49308, 49520, 52256, 60968, 64169, 69991, 71769, 78051		

Females		
Colantha 4th	35028	2
Lady Longfield 2d's Night	59192	2
Females appearing once for which only herd book number need be given. 10725, 16275, 21223, 30836, 32290, 33403, 33788, 34745, 39453, 42168, 50665, 53334, 53646, 60649		

THIRD GENERATION Males		
Homestead Jr. DeKol	28400	6
Mercedes Julips Pietj.'s Paul	29830	5
Aaltje Salo 3d's Tritomia Netherland	19856	4
Hengerveld DeKol	23102	4
Paul DeKol Jr.	24762	4
Sarcastic	4729	3
Maurice Clothilde	17638	3
DeKol 2d's Paul DeKol	20735	3
Pietj. Hengerveld Paul DeKol	22128	3
Sarcastic Lad	23971	3
Pontiac Korndyke	25982	3
Milla's Pietertje Netherland	7825	2
Silvan Hartog	8161	2
Sir Abbekerk	19056	2
Empress Josephine 3d's Sir Mechthilde	20255	2
Manor DeKol	21226	2
Johanna Rue 2d's Paul DeKol	21724	2
Maurice Bonheur	22394	2
Manor Josephine DeKol	22779	2
Billy McKinley	23378	2
Sir Johanna	23446	2
Admiral Walker	25755	2
Korndyke Queen DeKol's Prince	26025	2
Sir Ormsby Hengerveld DeKol	31212	2
Fobes Tritomia Mutual DeKol	40534	2
Males appearing once for which only herd book number need be given. 199 N.H.B., 2767, 11584, 11822, 13979, 14222, 16406, 19108, 19484, 21506, 21530, 22235, 23027, 23224, 23226, 23260, 23447, 26935, 27525, 28133, 28176, 29302, 36168		

THIRD GENERATION Males		
DeKol 2d's Butter Boy	21366	6
Paul DeKol	14634	6
Aaggie Cornelia 5th's Clothilde Imperial	11822	4
Paul Mutual DeKol	18726	3
DeKol 2d's Paul DeKol	20735	3
Sir DeKol Mechthilde	21506	3
DeKol 2d's Butter Boy 3d	23260	3
Aaggie Grace's Pietj.'s Clothilde	20697	2
Maurice Bonheur	22394	2
Sir Inka Artic Mecht.	22584	2
Mutual Friend 3d's Paul	23200	2
Gem Pietj. Heng. Paul DeKol	23300	2
Vevie Night DeKol	23637	2
Sir Piebe DeKol	26239	2
Johanna Rue 3d's Lad	26939	2
Males appearing once for which only herd book number need be given. 407D–F.H.B., 588 H.H.B., 1022 H.H.B., 3463 H.H.B., 3337, 11584, 13821, 15243, 15437, 16179, 16406, 17064, 21226, 21530, 23022, 23224, 23227, 23366, 23446, 23450, 23469, 23971, 25368, 25822, 25982, 26221, 26935, 28176, 29830, 35077		

Females			Females		
A & G. Inka McKinley	55163	6	Magadora	29237	4
Grace Fayne 2d	44124	6	DeKol 2d	734	3
DeKol 2d	734	4	Colantha	6714 H.H.B.	2
Belvisea 2d	4553	3	Jessie Beets	8123	2
Rose Bonheur 5th	11227	3	Johanna 5th	9343	2
Netherland Hengerveld	13106	3	Belle Sarcastic	23039	2
Aaggie Cornucopia	21127	3	Pietertje Hengerveld	24137	2
Grace Fayne	37845	3	Johanna Rue 2d	33788	2
Homestead Heroine DeKol	46490	3	Colantha 4th	35028	2
Kate Korndyke	238D—F.H.B.	2	Lady Longfield 2d	37842	2
Belle Korndyke	13913	2	Pietertje Maid of Grouw	42832	2
Duchess Ormsby	16004	2	Almeda Luecke 2d	49520	2
Belle Sarcastic	23039	2			
Agnes DeKol's Ellen	30228	2			
Lunde Beauty	34745	2			
Colantha 4th	35028	2			
Johanna Aaggie	36477	2			
Pontiac Lunde Hengerveld	51585	2			
Pontiac Darkness	65765	2			
Females appearing once for which only herd book number need be given, 2199 H.H.B., 6245 H.H.B., 8494 H.H.B., 2129, 18449, 19528, 29065, 29312, 51477, 33788, 35164, 35167, 35907, 35909, 36478, 38944, 41934, 48426, 48577, 49131, 49308, 49657, 50665, 50734, 53334, 53646, 66793, 69991			Females appearing once for which only herd book number need be given. 1516D—F.H.B., 7159 H.H.B., 7403, 10513, 10723, 19524, 20009, 22916, 26731, 27881, 28389, 30836, 32004, 32259, 34799, 35439, 36429, 36478, 37486, 38944, 39947, 40082, 41332, 41934, 41944, 42167, 42168, 48426, 51585, 55163, 64169, 78051		

FOURTH GENERATION Males			FOURTH GENERATION Males		
Paul DeKol	14634	9	Paul DeKol	14634	10
Aaltje Salo 3d's Tritomia Netherland	19856	9	DeKol 2d's Prince	2767	6
Paul DeKol Jr.	24762	6	Milla's Pietertje Netherland	7825	6
Billy McKinley	23378	6	Sir Abbekerk	19056	6
DeKol 2d's Butter Boy	21366	6	Aaltje Salo 3d's Tritomia Netherland	19856	6
Johanna Rue 2d's Paul DeKol	21724	5	Manor DeKol	21226	5
DeKol 2d's Paul DeKol	20735	5	Aaggie Cornelia 5th's Clothilde Imperial	11822	5
Aaggie Cornelia 5th's Clothilde Imperial	11822	5	Sarcastic Lad	23971	4
Willem III	190 N.H.B.	4	Clothilde 4th's Imperial	1281	4
Tritomia's Netherland Carl	16406	4	Inka Princess' Pietj. Netherland	13979	4
Paul Mutual DeKol	18726	4	DeKol 2d's Paul DeKol	20735	3
Prince Nicolaas	361D—F.H.B.	3	Willem III	190 N.H.B.	3
Jupiter	628D—F.H.B.	3	DeKol 2d's Netherland	11584	3
Aaggie Leila's Prince	4419 H.H.B.	3	Sir Parthenea Mechthilde	19667	3
Duke Netherland	1271	3	DeKol 2d's Butter Boy	21366	3
Meadowbrook Chief	1969	3	Piebe DeKol Burke	25368	3
Aaggie 3d's Prince	5148	3	Nicholas	185 N.H.B.	2
Uncle Hicks 6th	6154	3	Billy Boelyn	189 H.H.B.	2
Mechthilde Sir Henry of Maplewood	6296	3	Pel 2d	327D—F.H.B.	2
Clothilde 3d's Netherland	10156	3	Conqueror	388 H.H.B.	2
DeKol 2d's Netherland	11584	3	Burly	394 H.H.B.	2
Inka Princess Pietj. Netherland	13979	3	Mooie Hartog 4th	418D—F.H.B.	2
Elaine's Pietertje	20854	3	Oakland Chief	3259 H.H.B.	2
Pietj. Hengerveld's Paul DeKol	22128	3	Netherland Carl	3279 H.H.B.	2
Maurice Bonheur	22394	3	Netherland Alban	4584 H.H.B.	2
Manor Josephine DeKol	22779	3	Sarcastic	4729	2
Hengerveld DeKol	23102	3	Artis Adiantum's Clothilde	15202	2

Paul Hartog	6 M.R.	2	Maurice Clothilde	17038	2
Prince of Monroe	1630 H.H.B.	2	Lady of Lyons Prince	18025	2
Sarcastic	4729	2	Paul Mutual DeKol	18726	2
Silvan Hartog	8161	2	Paul DeKol Clothilde	21198	2
Pietertje 2d's Koningin	19625	2	Sir DeKol Mechthilde	21596	2
Prince of Ninety	15243	2	Johanna Rue 2d's Paul DeKol	21724	2
Tirania's Sir Mechthilde	16469	2	Pietj. Hengerveld's Paul DeKol	22128	2
DeKol 2d's Alban	17064	2	Inka Princess Pietj. Pledge	22324	2
Maurice Clothilde	17638	2	Pauline Paul 2d's Count	22909	2
Empress Josephine 3d's Sir Mechthilde	20255	2	DeKol Burke	22991	2
Manor DeKol	21226	2	Baron Pauline DeKol	23226	2
Aaggie Beauty 2d's Hero	21400	2	Pearl of the Dairy's Joe DeKol	23450	2
Sir DeKol Mechthilde	21596	2			
Capitola Duke	21530	2			
Lorraine Prince	23109	2			
Pietj. Alban DeKol	23227	2			
DeKol 2d's Butter Boy 3d	23260	2			
Gem Pietertje Hengerveld Paul DeKol	23300	2			
DeKol 2d's Paul DeKol No. 2	23366	2			
Pontiac Korndyke	25982	2			
Homestead Jr. DeKol	28490	2			
Mooie Mutual DeKol	32846	2			

Males appearing once for which only herd book number need be given. 204 H.H.B., 1164 H.H.B., 1916H.H.B., 3279H.H.B., 4584 H.H.B., 1281, 7490, 7825, 12121, 18342, 18508, 19667, 20383, 22091, 23027, 23446, 23450, 23469, 23711, 23971, 25089, 25368, 25871, 29830

Males appearing once for which only herd book number need be given. 497D—F.H.B., 1115 H.H.B., 2150 H.H.B., 4152 H.H.B., 1, 855, 1271, 1607, 6154, 7490, 9130, 11731, 12121, 13821, 14222 14881, 15927, 16406, 17064, 18342, 18924, 19108, 19308 19653, 20214, 20383, 21676, 22394, 22779, 23102, 23224, 23378, 25700, 25755, 25795, 31212

Females			Females		
Homestead Heroine DeKol	46490	6	DeKol 2d	734	14
Grace Fayne	57849	6	Netherland Hengerveld	13106	7
Segis Inka	36617	6	Pauline Paul	2199 H.H.B.	6
DeKol 2d	734	6	Johanna	344 H.H.B.	4
Mercedes Julip's Pietertje	39480	5	Aaggie Cornelia 5th	6733 H.H.B.	4
DeKol	6245 H.H.B.	4	Johanna Rue	21223	4
Aaltje Salo 3d	7403	4	DeKol 2d's Queen	6324	4
Belle Korndyke	13913	4	DeKol	6245 H.H.B.	3
Pietertje Hengerveld	24137	4	Mutual Friend 2d	10513	3
Sadie Vale Concordia	32249	4	Duchess Ormsby	16004	3
Johanna Rue 2d	33788	4	Colantha	6714 H.H.B.	2
Rosa Bonheur	890 H.H.B.	3	Dora Beets 3d	26SD—F.H.B.	2
Yonge Span	893D—F.H.B.	3	Mutual Friend	10139 H.H.B.	2
Belvisia	1675D—F.H.B.	3	Belvisia 2d	4553	2
Cornucopia	8687 H.H.B.	3	Johanna 5th	9343	2
Madame Hengerveld	1333	3	Rosa Bonheur 5th	11227	2
Chloe Artis Netherland	20229	3	Belle Korndyke	13913	2
Belle Sarcastic	23039	3	Vevie Night 2d	16002	2
Clara Doland	23833	3	Pleasant Valley Maid's Pietertje	18314	2
Mercedes Julip	33403	3	Sadie Vale 2d	18449	2
Heroine DeKol	41387	3	Almeda Luecke	19528	2
Korndyke Queen DeKol	41934	3	Aaggie Grace's Pietertje	26732	2
3d Maartje Korndyke	17M.R.	2	Mutual Friend 3d	28389	2
Kate Korndyke	238D—F.H.B.	2	Piebe Queen	29065	2
Lutske 2d	267D—F.H.B.	2	Lady Longfield	32290	2
Segis	5765 H.H.B.	2	Maplecroft Gem	35909	2
Milla	6408 H.H.B.	2	Johanna Rue 3d	42167	2
Colantha	6714 H.H.B.	2	Wisconsin Bess	45146	2

Empress Josephine 3d	1995	2			
Johanna 4th	2129	2			
Belvisea 2d	4553	2			
DeKol 2d's Queen	6324	2			
Piebe 2d	7402	2			
Rosa Bonheur 5th	11227	2			
Alberta Abbekerk 2d	12702	2			
Netherland Hengerveld	13196	2			
Pleasant Valley Maid's Pietertje	18314	2			
Agnes DeKol	20200	2			
Johanna Rue	21223	2			
Lunde 3d's Perfection	27881	2			
Agnes DeKol's Ellen	30228	2			
Lunde Beauty	34745	2			
Colantha 4th	35028	2			
Duchess Ormsby 2d	35439	2			
Lillian Walker	38944	2			
Inka Darkness 2d's Queen	40182	2			
Pietertje Maid of Grouw	42832	2			
Jessie Fobes 2d's Tritomia	44130	2			
Females appearing once for which only herd book number need be given. 344 H.H.B., 677 H.H.B., 2199 H.H.B., 2372 H.H.B., 2618 H.H.B., 3162 H.H.B., 4004 H.H.B., 6733 H.H.B., 2575, 7970, 8123, 10725, 10933, 12586, 13050, 21127, 34741, 35159, 35167, 36477, 39947, 40082, 40675, 41944, 44887, 49657, 51297, 55163			Females appearing once for which only herd book number need be given. 539 H.H.B., 542 H.H.B., 954 H.H.B., 4004 H.H.B., 5868 H.H.B., 6001 H.H.B., 6651 H.H.B. 8494 H.H.B., 10167 H.H.B., 733, 1128, 2125 9702, 13050, 17274, 17498 21127, 23039, 24137, 24636 27463, 30759, 32259, 32285 33688, 33788, 34628, 34745 34740, 35159, 35547, 36420 36477, 36478, 36617, 37957 39480, 39947, 43434, 53334 53646, 60968		

The animals occurring in the first generation of any pedigree do not have the same chance to repeat as do the animals in the second generation, due to the fact that the actual number of animals in the first generation is only half that in the second generation. Likewise the animals in the second generation do not have the same chance to repeat as do the animals in generations further removed. It is consequently more to the credit of any animal to be repeated once in the first generation than to be repeated once in subsequent generations. This point should be kept in mind in viewing the evidence presented in the table.

The accompanying table 9 shows that of those bulls whose daughters were significantly higher in their milk yield than the rest of the breed, three were sired by each of the following bulls, Sarcastic Lad, Sir Fayne Concordia, and King Fayne Segis and two each were sired by the bulls, Pontiac Korndyke, Aaggie Concordia Johanna, King Segis and King of the Pontiacs. Two each of these sires were out of the cows, Colantha 4th's Johanna, Piebe Longfield Night and Manor DeKol Kate 2d.

For the second generation similar information is given for the number of appearances of the animals of this group of pedigrees. King Segis is shown to be the grandsire of five of the sires with high testing daughters. This is two more than his nearest competitors Maurice Bonheur and Homestead Jr. DeKol. On the dam's side Hengerveld DeKol is repeated 4 times as the grandsire of the sires whose daughters' milk yield is high. It will be noted that the only bull to appear as a grandsire twice in both the sire's and the dam's side of the pedigree is Sarcastic Lad.

In the third generation Homestead Jr. DeKol appears 6 times in the pedigrees. His next competitor is Mercedes Julip Pietertje's Paul (appears 5 times.) Two bulls appear 6 times on the dam's side of the pedigree, they are DeKol 2d's Butter Boy and Paul DeKol. Two cows appear 6 times on the sire's side of the pedigree in this generation; these cows are A & G. Inka McKinley and Grace Fayne 2d. The cow with the greatest number of appearances on the dam's side in this generation is Magadora (appears 4 times).

Paul DeKol has more appearances in the fourth generation, on either the sire's or the dam's side of the pedigree, than any other bull. The other repeated bulls which appear in any generation may be seen in the table.

One feature of this table 9, noticeable on inspection, is that there are more repetitions of a given animal on the sire's side of the pedigree than on the dam's side of the pedigree. This holds true for both the bulls and cows. Since the popularity of an animal is based on what is conceived to be his worth, it follows from the above that the animals considered to be worth most are included in the sire's side of the pedigree more often than they are included in the dam's side of the pedigree. Such a selection would seem to mean that the sires are more carefully chosen than the dams to which they are bred.

That the number of times a given individual appears in a group of pedigrees measure to a certain extent the influence of that individual on whether or not the resulting offspring is good or bad seem to be a reasonable supposition. Since these pedigrees being dealt with, are those of sires whose daughters were significantly high in their milk yield it would follow from the above that those animals appearing most often in them were

most responsible for these sires' merits. The summary of these animals for the four generations pedigreed, is given below in order of their number of appearances. The number of these appearances is given in parenthesis following the name. The appearances on the sire's side being given first and those on the dam's side second. All bulls or cows occurring more than 4 times are given. The bulls are Paul DeKol (10-16), Aaltje Salo 3d's Tritomia Netherland (13-7), DeKol 2d's Butter-Boy (8-9), Sarcastic Lad (9-7), DeKol 2d's Paul DeKol (8-7), Aaggie Cornelia 5th's Clothilde Imperial (6-9), Hengerveld DeKol (8-5), Manor DeKol (5-6), Maurice Bonheur (8-3), Homestead Jr. DeKol (11-0), Paul Mutual DeKol (4-6), DeKol 2d's Butter Boy 3d (6-4), Paul DeKol Jr. (10-0), Pontiac Korndyke (9-1), Johanna Rue 2d's Paul DeKol (7-2), Billy McKinley (8-1), King Segis (8-1), Milla's Pieterje Netherland (3-6); Willem III (5-3), DeKol 2d's Netherland (4-4), Inka Princess Pietertje Netherland (4-4), Sir Abbekerk (2-6), Sir DeKol Mechthilde (3-5), Pietertje Hengerveld's Paul DeKol (6-2), Manor Josephine DeKol (7-1), Mercedes Julips Pietertje's Paul (7-1), DeKol 2d's Prince (1-6), Sarcastic (5-2), Tritomia's Netherland Carl (5-2), Maurice Clothilde (5-2), Sir Johanna (3-3), Johanna Aaggie's Sarcastic Lad (4-1), Clothilde 4th's Imperial (1-4), Pietertje Hengerveld's Count DeKol (2-3), Gem Pietertje Hengerveld Paul DeKol (3-2), Piebe DeKol Burke (1-4), Admiral Walker (3-2), Sir Ormsby Hengerveld DeKol (3-2), Sir Fayne Concordia (5-0), Duke Netherland (3-1), Uncle Hicks 6th (3-1), Silvan Hartog (4-0), DeKol 2d's Alban (2-2), Sir Parthenea Mechthilde (1-3), Empress Josephine 3d's Sir Mechthilde (4-0), Elaine's Pietertje (3-1), Capitola Duke (3-1), DeKol Burke (1-3), DeKol 2d's Paul DeKol No. 2 (2-2), Pearl of the Dairy's Joe DeKol (1-3), Aaggie Cornucopia Johanna Lad (3-1), King of the Pontiacs (3-1).

The females appearing more than 4 times are DeKol 2d (11-17), Netherland Hengerveld (5-7), Belle Sarcastic (8-3), Mercedes Julips' Pietertje (8-2), A & G. Inka McKinley (9-1), Belle Korndyke (8-2), Magadora (5-4), Johanna Rue 2d (5-4), Homestead Heroine DeKol (9-0), Grace Fayne 2d (9-0), Grace Fayne (9-0), Segis Inka (8-1), Pauline Paul (2-6), Pietertje Hengerveld (5-3), DeKol (5-3), Colantha 4th (4-4), Johanna Rue (2-5), Sadie Vale Concordia (5-2), Belvisia 2d (5-2), Rosa

Bonheur 5th (5-2), Aaggie Cornucopia (4-1), Johanna Aaggie (4-1), Lunde Beauty (4-2), Pontiac Lunde Hengerveld (4-2), Colantha (2-4), DeKol 2d's Queen (2-4), Aaggie Cornucopia Pauline (4-1), Aaltje Salo 3d (4-1), Aaggie Cornelia 5th (1-4), Johanna (1-4), Korndyke Queen DeKol (4-1), Colantha 4th's Johanna (3-2), Duchess Ormsby (2-2), Johanna 5th (0-4), Mutual Friend 2d (0-4), Agnes DeKol's Ellen (4-0), Kate Korndyke (4-0), Lillian Walker (3-1), Mercedes Julip (3-1), Pleasant Valley Maid's Pietertje (2-2), Duchess Ormsby 2d (3-1), Johanna Rue 3d (0-4).

The reader cannot but notice that most of these animals' names are familiar household words of the Holstein-Friesian breeder. One bull, Paul DeKol and one cow DeKol 2d are quite significantly higher in the number of times they appear as compared with the rest of the sires and dams. Most of the animals like DeKol 2d's Butter Boy appear to be evenly distributed as to the side of the pedigree in which they appear. Other animals like Aaltje Salo 3d's Tritomia Netherland, Homestead Jr. DeKol, Paul DeKol Jr., Pontiac Korndyke etc. appear largely on one side of the pedigree. The side of the pedigree generally favored appears to be sire's side.

Animals Appearing in the Pedigrees of the Sires which Have Daughters with a Significantly Low Milk Yield

As the previous discussion points out the greatest interest of these results lies in the comparison of the animals tabulated above with the list of animals which appears in the pedigrees of those sires whose daughters were significantly low in their milk yield. The list of sires of these low producing daughters is given on page 152. The animals repeated in the pedigrees of these sires are given below. The arrangement of this table is entirely similar to that previously presented.

TABLE 12.

Animals repeated in the pedigrees of sires whose daughters were significantly high or low milk producers or high or low in their butter-fat percentage. This table is for those sires whose daughters were significantly low in their milk yield.

Sire's Side of Pedigree Name	H.B. No.	No. of Appearances	Dam's Side of Pedigree Name	H.B. No.	No. of Appearances
FIRST GENERATION Males			FIRST GENERATION Females		
Homestead Girl DeKol Sarcastic Lad	32558	2			
Males appearing once for which only herd book number need be given. 8132, 18726, 21226, 22128, 22394, 23260, 23300, 25368, 25700, 26766, 28133, 38835, 39037, 41266, 44444			Females appearing once for which only herd book number need be given. 13913, 16004, 17274, 23039, 33788, 35439, 35907, 36579, 60649		
SECOND GENERATION Males			SECOND GENERATION Males		
Hengerveld DeKol	23102	2	Hengerveld DeKol	23102	2
Pontiac Korndyke	25982	2			
King Segis	36168	2			
Males appearing once for which only herd book number need be given. 11584, 14634, 13038, 20735, 21226, 21228, 22909, 22991, 23200, 23260, 26766, 28137, 35269, 46767			Males appearing once for which only herd book number need be given. 1002 H.H.B., 4729, 6154, 8161, 11822, 16406, 17064, 18458, 21329, 22991, 23224, 23969, 25822, 29521, 36168.		
Females			Females		
DeKol 2d	734	2			
Homestead Girl DeKol	48423	2			
Females appearing once for which only herd book number need be given. 10513, 11227, 13106, 13913, 24137, 32496, 35909, 37957, 39530, 41934, 51585, 53334, 55163, 65765, 69991			Females appearing once for which only herd book number need be given. 238D—F.H.B., 2372 H.H.B., 1286, 4553, 7402, 9606, 16004, 21223, 27463, 36579, 37486		
THIRD GENERATION Males			THIRD GENERATION Males		
DeKol 2d's Paul DeKol	20735	5	DeKol 2d's Butter Boy	21366	5
Paul DeKol	14634	4			
DeKol 2d's Butter Boy	21366	3			
Manor Josephine DeKol	22779	3			
Sarcastic Lad	23971	3			
Willem III	190 N.H.B.	2			
Milla's Pietertje Netherland	7825	2			
DeKol 2d's Netherland	11584	2			
Manor DeKol	21226	2			
Hengerveld DeKol	23102	2			
Pontiac Korndyke	25982	2	Males appearing once for which only herd book number need be given. 361D—F.H.B., 388 H.H.B., 588 H.H.B., 628D—F.H.B., 686D—F.H.B., 1060 H.H.B., 1630 H.H.B., 3279 H.H.B., 4152 H.H.B., 4584 H.H.B., 1281, 3914, 6154, 13821, 13853, 18458, 19056, 19308, 20676, 21226, 21676, 22128, 22584, 22894, 26345, 28133, 29830, 31943		
Mercedes Julip's Pietertje Paul	29830	2			
Males appearing once for which only herd book number need be given. 4419 H.H.B., 4584 H.H.B., 1, 1969, 2767, 8781, 10156, 17064, 19108, 19484, 19668, 22187, 23224, 23260, 23378, 23469, 25755, 26025, 29521, 36168					

Females		
DeKol 2d	734	4
Johanna Aaggie	36477	3
DeKol	6245 H.H.B.	2
Netherland Hengerveld	13106	2
Belle Korndyke	13913	2
Homestead Girl	16275	2
Magadora	29237	2
A & G. Inka McKinley	55163	2
Females appearing once for which only herd book number need be given. 890 H.H.B., 2199 H.H.B., 10013 H.H.B., 10139 H.H.B., 1333, 6322, 10513, 10536, 15681, 20229, 22916, 24137, 28389, 29065, 31477, 32496, 34745, 36420, 36617, 40082, 40182, 41934, 49308, 49657, 68828		

Females		
Magadora	29237	2
Females appearing once for which only herd book number need be given. 267D—F.H.B., 344 H.H.B., 542 H.H.B. 893D—F.H.B., 938D—F.H.B., 1675D—F.H.B., 1907D—F.H.B., 4004 H.H.B., 5739 H.H.B., 5975 H.H.B., 6733 H.H.B., 8466 H.H.B., 7402, 9343 9606, 18314, 22916, 24137 30759, 34740, 34741, 35907, 50663, 55163		

FOURTH GENERATION Males		
Paul DeKol	14634	6
Willem III	190 N.H.B.	4
DeKol 2d's Prince	2767	4
Netherland Alban	4584 H.H.B.	3
Duke Netherland	1271	3
Milla's Pietertje Netherland	7825	3
Silvan Hartog	8161	3
DeKol 2d's Netherland	11584	3
Aaggie Cornelia 5th's Clothilde Imperial	11822	3
Sir Abbekerk	19056	3
DeKol 2d's Butter Boy	21366	3
Maurice Bonheur	22394	3
Netherland Statesman	3280 H.H.B.	2
Aaggie Leila's Prince	4419 H.H.B.	2
Sir Henry Beatus	3337	2
Empress Josephine 3d's Metchthilde	20255	2
Manor DeKol	21226	2
Johanna Rue 2d's Paul DeKol	21724	2
Hengerveld DeKol	23102	2
Billy McKinley	23378	2
Males appearing once for which only herd book number need be given. 204 H.H.B., 322D—F.H.B., 686D—F.H.B., 716 H.H.B., 1916 H.H.B., 3463 H.H.B., 1, 855, 6154, 8781, 11731, 12121, 13979, 14881, 15243, 17713, 18924, 20214, 20657, 20735, 21400, 21530, 22235, 22324, 22779, 23027, 23109, 23224, 26345, 26939, 28400, 29830		

FOURTH GENERATION Males		
Milla's Pietertje Netherland	7825	8
Sir Abbekerk	19056	5
Netherland Prince	716 H.H.B.	3
DeKol 2d's Netherland	11584	2
Inka 5th's Pietertje	13853	2
Artis' Adiantum's Clothilde	15202	2
DeKol 2d's Alban	17064	2
Lord Netherland DeKol	22187	2
DeKol 2d's Butter Boy 3d	23260	2
Males appearing once for which only herd book number need be given. 122 F.H.B., 189 H.H.B., 190 N.H.B., 322D—F.H.B., 588 H.H.B., 686D—F.H.B., 1060 H.H.B., 1164 H.H.B., 3087 H.H.B., 3259 H.H.B., 4152 H.H.B., 4584 H.H.B., 1281, 1607, 3914, 6296, 11731, 12525, 14634, 16469, 18458, 18924, 20578, 20735, 21226, 21329, 21724, 23378, 25700, 27945, 28133		

Females		
DeKol 2d	734	13
Netherland Hengerveld	13106	5
Pauline Paul	2199 H.H.B.	5
DeKol	6245 H.H.B.	4
Kate Korndyke	238D—F.H.B.	3
Johanna 4th	2129	3
Belle Korndyke	13913	3
Belle Sarcastic	23039	3

Females		
DeKol 2d	734	5
Netherland Hengerveld	13106	4
Pleasant Valley Maid	9431 H.H.B.	2

Milla	6408 H.H.B.	2			
Napoli	7159 H.H.B.	2			
Mutual Friend	10139 H.H.B.	2			
Madame Hengerveld	1333	2			
Magadora	29237	2			
Agnes DeKol's Ellen	30228	2			
Segis Inka	36617	2			
Lillian Walker	38944	2			
Mercedes Julip's Pietertje	39489	2			
Females appearing once for which only herd book number need be given. 677 H.H.B., 954 H.H.B., 2654 H.H.B., 5765 H.H.B., 733, 2575, 6322, 6324, 9702, 10536, 10933, 17498, 18314, 21127, 24137, 26722, 27881, 33688, 34741, 35167, 41934, 44124, 50663, 55163			Females appearing once for which only herd book number need be given. 184 N.H.B., 344 H.H.B., 539 H.H.B., 938D—F.H.B., 1892D—F.H.B., 1907D—F.H.B., 2372 H.H.B., 265 H.H.B., 2767 H.H.B., 3772 H.H.B., 5939 H.H.B., 5975 H.H.B., 6245 H.H.B., 733, 1286, 2125, 4288, 9392, 12702, 22916, 24137, 24636, 27463, 28389, 32259, 36617, 39489, 41934, 46762, 50734		

Only one animal, Homestead Girl DeKol Sarcastic Lad is the sire or dam of more than one bull whose daughters are significantly low in their milk yield.

In the second generation three bulls, Hengerveld DeKol, Pontiac Korndyke and King Segis appear twice as grandsires on the sire's side. One bull, Hengerveld DeKol has two appearances on the dam's side. Two females, DeKol 2d and Homestead Girl DeKol appear twice on the sire's side of the pedigrees.

In the third generation the greatest number of appearances for any one bull or cow is 5. This is on the sire's side. In the fourth generation the greatest number of appearances is 13. This, also, is on the sire's side.

It will be noted that this list includes many famous Holstein-Friesian bulls and cows. A summary of the total number of appearances made by any one animal for the four generations is given below. The order of the presentation of the names is the order of their frequency of appearance. The number of these appearances is given in parethensis following the name,—those on the sire's side are given first followed by those on the dam's side. The bulls which appear three or more times are: *Milla's Pietertje Netherland* (5-8), *Paul DeKol* (11-1), *Dekol 2d's Butter Boy* (6-5), *Sir Abbekerk* (3-6), *DeKol 2d's Paul DeKol* (7-1), *Hengerveld DeKol* (6-2), *Manor DeKol* (6-2), *DeKol 2d's Netherland* (6-2), *Willem III* (6-1), *Netherland Alban* (4-2), *DeKol 2d's Butter Boy 3d* (3-2), *DeKol 2d's Prince*

(5-0), *Aaggie Cornelia 5th's Clothilde Imperial* (3-1), *Maurice Bonheur* (4-0), *Pontiac Korndyke* (4-0), *Billy McKinley* (3-1), *King Segis* (3-1), *Mercedes Julip's Pietertje's Paul* (3-1), *Manor Josephine DeKol* (4-0), *Silvan Hartog* (3-1), *DeKol 2d's Alban* (1-3), *Netherland Prince* (1-3), *Sir Korndyke Manor DeKol* (2-2), *Sarcastic Lad* (3-0), *Johanna Rue 2d's Paul DeKol* (2-1), *Pietertje Hengerveld's Paul DeKol* (2-1), *Pietertje Hengerveld's Count DeKol* (2-1), *Uncle Hick's* 6th (1-2), *Duke Netherland* (3-0), Lord Netherland DeKol (1-2), Inka 5th's Pietertje (0-3), Pietertje Paul (0-3), Hamilton (1-2), *Aaggie Leila's Prince* (3-0).

The females appearing more than 3 times are *DeKol 2d* (19-5), *Netherland Hengerveld* (8-4), *Belle Korndyke* (6-1), *DeKol* (6-1), *Magadora* (4-2), *Pauline Paul* (6-0), *A & G. Inka McKinley* (4-1), *Pietertje Hengerveld* (3-2), *Belle Sarcastic* (3-1), *Segis Inka* (3-1), *Korndyke Queen DeKol* (3-1), *Kate Korndyke* (3-1), *Mercedes Julip's Pietertje* (2-1), *Johanna Aaggie* (3-0), *Johanna 4th* (3-0), *Madame Hengerveld* (3-0), *Mutual Friend* (3-0), *Helena Burke* (1-2).

It will be noted that certain of the bulls and cows are in *italics*. These bulls or cows will also be found in table 9 for the animals appearing in the list of sires whose daughters' milk yield is significantly more than the rest of the breed. Most animals of either sex which appear any appreciable number of times in the pedigrees of the sires of low producing daughters are also animals that appear in the pedigrees of bulls which sired high producing daughters.

The arrangement of the lists for the sires of high producing daughters is such as to include only those animals appearing at least 4 times within these pedigrees. The list for the sires of the low producing daughters as given above includes only those animals which appear 3 or more times in the pedigrees of such sires.

It is found that of the animals not appearing in the above lists, *in italics*, only 5 have no appearance in the complete lists of animals appearing in the pedigrees of the sires of high producing daughters (table 11).

When the animals of the low producing group of pedigrees appear in the pedigrees of the supposed high producing group and the appearances are in nearly the same proportion how is

the breeder to determine from an animal's pedigree whether that animal is going to be a high producer? The answer would seem to be that the breeder cannot tell. From this, the conclusion seems justified that because a prominent bull or cow appears in a pedigree, it is no necessary guarantee that the animal in whose pedigree it appears is likely to be a high or low producer.

Before this conclusion is finally drawn it is necessary to examine the list of bulls and cows appearing in the pedigrees of the sires whose daughters were high producers (page 150) in conjunction with the complete list of animals appearing in the list of sires whose daughters were low producers as given in table 12. The results of this comparison show that out of a total of 52 animals appearing 4 times in the pedigrees of the sires, whose daughters were high milk producers, only 11 did not appear at least once in the pedigrees of the sires whose daughters were low milk producers. Of the 41 cows appearing at least 4 times in the pedigrees of the sires of high producing daughters only 9 did not appear once in the pedigrees of the sires whose daughters' milk flow was low.

Certain interesting anomalies appear in this study. Where normally the animals within the pedigrees of the high producing group, not appearing in the pedigrees of the sires of the low producing daughters, are, as a rule, those which have relatively few appearances in the pedigrees of the high producing group; there are two bulls and two cows which appear a good number of times in the high group and still do not appear in the inferior group. These are Aaltje Salo 3d's Tritomia Netherland, Paul DeKol Jr., Homestead Heroine DeKol and Grace Fayne. Further it will be noted that these animals have a large excess of their appearances on the sire's side of the pedigree. Such isolated examples as these make it clear that there may be animals of particular merit which may assist in predicting the value of an animal from its pedigree but that these animals are on the whole very rare.

The study can be carried further, however, by the mathematical analytical methods at our command. If we correlate the number of appearances given bulls have in one group with the number of appearances that they have in another group, a measure will be obtained which determines the probability of appearance in a given group (a) when the correlation for the

appearances is in a second group (b) are known. The question arises what these correlations should theoretically be on the theory which we are attempting to test, "like begets like." If an excellent animal always begets an excellent animal the expectation is that the animals who are most repeated in the pedigrees of the group of sires whose daughters are high producers are themselves transmitters of this excellence. By like reasoning the animals which appear in the inferior group pedigrees should transmit poor milk producing qualities. There should, therefore, be no animal in one group which appears in the other group, in other words, there should be a complete correlation against an animal which appears in one group, appearing in the other. Now, one would in actual practice never expect to get this complete negative correlation for under such conditions it would be subject to several selective agencies. How much it would be subjected to such agencies as random sampling, etc. one cannot say. But even granting that the measure is subject to those agencies it should be a good measure of our theory of "like begets like."

These correlation tables have been made and computed for each group of sires (those with high milking daughters and those with low milking daughters). They have further been made to include those animals appearing on the sire's side of the pedigree with the animals appearing on the dam's side of the pedigree. The results of this analysis are given below. In this table the symbols have the following meanings:

Milk + Sires' males means those bulls appearing on the sire's side of the pedigrees of the sires whose daughters are high milk producers.

Milk + Sires' females means those cows appearing on the sire's side of the pedigrees of the sires whose daughters are high milk producers.

Milk + Dams' males means those bulls appearing on the dam's side of the pedigrees of the sires whose daughters are high milk producers.

Milk + Dam's females means those cows appearing on the dam's side of the pedigrees of the sires whose daughters are high milk producers.

Milk — Sires' males means those bulls appearing on the sire's side of the pedigrees of the sires whose daughters are low producers.

Milk — Sires' Females means those cows appearing on the sire's side of the pedigrees of the sires whose daughters are low producers.

Milk — Dams' Males means those bulls appearing on the dam's side of the pedigrees of the sires whose daughters are low producers.

Milk — Dams' Females means those cows appearing on the dam's side of the pedigrees of the sires whose daughters are low producers.

TABLE 13.

Correlation coefficients between the number of appearances of animals within the pedigrees of the sires whose milk yield was high and the number of appearances of the same animals within the pedigrees of the sires whose milk yield was low.

Groups Correlated	Correlation Coefficient
Milk+Sire's males and Milk+Dam's males	+0.484±.037
Milk+Sire's males and Milk—Sire's males	.569±.033
Milk+Sire's males and Milk—Dam's males	.090±.048
Milk+Dam's males and Milk—Sire's males	.634±.029
Milk+Dam's males and Milk—Dam's males	.288±.045
Milk—Sire's males and Milk—Dam's males	.324±.043
Milk+Sire's females and Milk+Dam's females	.336±.042
Milk+Sire's Females and Milk—Sire's females	.534±.034
Milk+Sire's females and Milk—Dam's females	.229±.045
Milk+Dam's females and Milk—Sire's females	.657±.027
Milk+Dam's females and Milk—Dam's females	.387±.040
Milk—Sire's females and Milk—Dam's females	.432±.038
Milk+both sides Males and milk—both sides Males	.595±.033
Milk+both sides Females and milk—both sides Females	.687±.027

Some surprises are contained in table 13. The correlation coefficients are all plus and practically all are significant. The correlation between the bulls appearing on the sire's side of the pedigree with those appearing on the dam's side of the pedigree for that group of sires whose daughters are high in milk production, is plus and of considerable size. This would be expected on the supposition that these animals transmitted high milk yield to their offspring. In a similar manner the plus correlation between the cows appearing on the sire's side with those appearing on the dam's side of the pedigree of the sires of high producing daughters is expected. So also are the similar plus correlation

coefficients expected for the bulls and cows of the group of sires which had daughters of low production. What is not expected is that the cross correlations between the plus and the minus group should be also high and plus. In fact these correlations show that a bull appearing in the pedigrees of sires of high producing daughters on the sire's side of the pedigree is more likely to appear on the sire's side of the pedigrees of the sires of low producing daughters than he is to appear in the pedigrees of the sires of high producing daughters on the dam's side of the pedigree. Other important cross correlations appear in this table. Thus females appearing on the dam's side of the pedigrees of the sires whose daughters are high producers are more likely to appear on the sire's side of the pedigrees of the sires whose daughters are low producers than they are to appear on the sire's side of the pedigree of the sires whose daughters are high producers.

These facts make it clear that the appearance of a famous animal in the pedigree of an untried bull is no guarantee of the worth of that bull as a sire of high milking daughters.

The comparison of the results for the animals appearing in the random sample pedigree group with those appearing in the low and high milking group will be postponed until the butter-fat percentage groups are considered.

Progeny Performance of Holstein-Friesian Sires' Daughters for Butter-Fat Percentage

The arrangement of table 14, containing the information on the average butter-fat percentage of the daughters of Holstein-Friesian sires, is entirely, similar to that of table 6. In this table is given the average butter-fat percentage of the daughters of all Holstein-Friesian sires which have two or more daughters with advanced registry records. These bulls are arranged according to the average butter-fat percentage of their daughters.

The first column of table 12 gives the number in the series of numbers occupied by the butter-fat percentage of the sires' daughters. The second column gives the name of the sire together with his registry number. The fourth column gives the number of daughters for each sire whose butter-fat percentages are averaged. These daughters have all full year tests. The

average butter-fat percentage for each sire's daughters is given in the fifth column of this table. In the last column is indicated the position of the sire's daughters butter-fat percentage in the whole breed's distribution of the butter-fat percentages. The coefficient or number before the letter gives the percentage that the daughters of a given group (letter) occupy in comparison to the whole number of daughters of the sire. The letters and their signficance are shown and discussed in tables 3 and 5. The figures for these show the place occupied by the letters. Each letter group is equal in numbers to any other letter group. The highest butter-fat testers are lettered *I* and the lowest *P*. *J* is the next to the highest butter-fat tester. The letters from the highest to lowest butter-fat testers take the order *I, J, K, L, M, N, O, P.*

The bull whose daughters averaged the highest in their butter-fat percentage of the 449 bulls who have recorded daughters, was King Hengerveld Aaggie Fayne. This bull had 3 daughters with an average butter-fat percentage of 4.503 per cent in their year tests. These three daughters were all in the highest group of butter-fat testers for the breed.

The second highest sire was Duchess Ormsby Prince with two daughters. These daughters averaged 4.270 per cent of butter-fat. They were both in the highest group of butter-fat testing cows. Table 14 gives the complete information for each of these 449 bulls.

TABLE 14.

Performance of the Progeny of Holstein-Friesian Sires for Butter-Fat Percentage

No.	Name	H. B. No.	No. of Daughters	Butter-Fat %	Octiles
1	King Hengerveld Aaggie Fayne	56635	3	4.503	100I
2	Duchess Ormsby Prince	25796	2	4.270	100I
3	Sir Inka DeKol Chief	53303	5	4.190	100I
4	McKinley Hengerveld DeKol	51505	2	4.165	100I
5	Kalmuck Skylark Johanna	48832	4	3.973	75I+25J
6	King Beauty Pietertje DeKol	50758	2	3.970	100I
7	King Mead of Riverside	50290	13	3.965	69I+8J+15L+8M
8	Friend Hengerveld DeKol Butter Boy	29303	5	3.958	80I+20J

Performance of the Progeny of Holstein-Friesian Sires for Butter-Fat Percentage.—Continued.

No.	Name	H. B. No.	No. of Daughters	Butter-Fat %	Octiles
9	Homestead Crown Prince DeKol	25865	4	3.948	75I+25K
10	Maple Crest Pontiac Hartog	62178	5	3.922	60I+20J+20K
11	Pontiac Aaggie Korndyke	38291	14	3.900	64I+14J+7K+7M+7O
12	Greenwood Johanna Lyons	62049	2	3.875	100I
13	Homestead Hengerveld Crown DeKol	26345	3	3.867	67I+33J
14	Prince Ormsby Mercedes DeKol	47008	3	3.840	67I+33L
15	Duchess Ormsby Piebe Burke	20328	4	3.830	75I+25J
16	Iowana Sir Ollie	114797	2	3.810	50I+50J
17	Sir Princess Johanna	57926	2	3.810	50I+50J
18	Zady Bergsma Butter Boy	28504	3	3.803	33I+67J
19	Crown Pauline Sir Hengerveld	41038	2	3.795	50I+50J
20	DeKol Hengerveld Burke	29737	2	3.790	50I+50J
21	Sir Johanna Rue DeKol	31387	2	3.785	50I+50M
22	Judge Hengerveld DeKol	43964	2	3.780	50I+50K
23	Juliana King of Riverside	38446	8	3.778	50I+25K+13L+13O
24	King of the Pontiacs	39037	37	3.774	14I+27J+11K+8L +3M+3N
25	Pietertje Hengerveld Segis	44781	3	3.770	33I+33J+33L
26	Aaggie Cornucopia Pauline Count 13th	44293	10	3.763	50I+30J+20L
27	Sir Korndyke Bess	110157	2	3.760	50I+50M
28	Sir Pontiac Beets Korndyke	37200	2	3.750	50I+50K
29	Rollingdale Pauline Beets	76861	2	3.740	50I+50K
30	Paul Cornucopia Mercedes Aaggie	91884	6	3.737	33I+33J+17K+17L
31	Duke Koningen	24819	2	3.730	50I+50O
32	Sir Jewel Parthenea Doede	38639	3	3.730	67I+33K
33	Sir Colantha Juliana	67203	2	3.730	50I+50L
34	Sir Drosky Abbekerk	43075	2	3.730	33I+33J+33K
35	Cornucopia Hengerveld DeKol	49221	3	3.727	67I+33O
36	Meibloem DeKol	46593	3	3.727	33I+33K+33L
37	Sindt Butter Boy	55237	3	3.720	33I+67J
38	Minnie Hark Pietertje Burke	57476	3	3.717	33I+33J+33L
39	Cornucopia Waukasha Prince	35119	2	3.715	50I+50L
40	Cornelia King	86166	3	3.710	33I+67K
41	Wooderest DeKol Lad	45103	4	3.708	50I+25K+25M
42	Paul Jewel DeKol Mechthilde	44916	2	3.705	50I+50K
43	Norwood Veeman Hengerveld DeKol	65916	2	3.705	50I+50L
44	Canary Paul	48328	6	3.703	33I+33J+33K
45	Sir Josephine Mechthilde Pietertje	32110	2	3.695	100J
46	Sir Pietertje Ormsby Mercedes 14th	81142	2	3.695	50I+50K
47	Aaggie 3d's Wayne's Paul DeKol	27868	4	3.690	25I+50J+25M
48	Pontiac Zephyrus	39426	4	3.688	25I+50J+25K
49	Sir Johanna Canary DeKol	44034	3	3.687	33J+33I+33N
50	Vale Mercedes Posch	41416	5	3.686	40I+20J+20L+20N
51	A & G Netherland Maud Piebe DeKol	32510	2	3.685	50I+50N
52	Aralia King	86837	5	3.680	20I+40J+20K+20M
53	Sir Veeman Hengerveld	36158	5	3.678	40I+20K+40L
54	Sir Pontiac DeKol Burke	50920	2	3.675	50I+50L
55	Hengerveld DeKol	23102	5	3.674	60I+20N+20O
56	Dan Patch Hark	37807	2	3.670	100J
57	Wooderest Pietje Ormsby	54909	2	3.670	50I+50L
58	Sir Pietertje Ormsby Mercedes	44931	36	3.667	31I+22J+14K+11L +14M+6O
59	Prex Korndyke DeKol	35900	2	3.665	50J+50K
60	King Oak Grove	42235	4	3.663	50I+25L+25M
61	DeKol Pietertje Prince 2d	27930	2	3.660	100J
62	King Champion Victoria	68544	5	3.660	40I+20J+20K+20O

Performance of the Progeny of Holstein-Friesian Sires for Butter-Fat Percentage.—Continued.

No.	Name	H. B. No.	No. of Daughters	Butter-Fat %	Octiles
63	Sir Paul Veeman Hengerveld	94217	7	3.659	14I+59J+29L
64	Canary Mercedes Paul	29600	6	3.657	33I+50K+17M
65	Dutchland Sir Mercena Rag Apple	51002	2	3.655	50J+50K
66	Sir Johanna Aaggie Posch	38401	7	3.653	29I+29J+14K+14M +14O
67	King of the Pontiacs 8th	63637	3	3.647	33I+33J+33N
68	Johanna Rue 3d's Lad	26939	5	3.646	40I+20K+40M
69	Sir Johanna Korndyke	42940	8	3.646	25I+38J+13K+13L +13P
70	Sir Daisy Mercedes DeKol (Twin)	28982	2	3.645	50I+50M
71	Pontiac Carlotta Gerben	45807	4	3.640	25I+25J+25K+25M
72	Clear View Jimmy Koningen	51067	2	3.635	100J
73	Johanna Pontiac DeKol	41980	5	3.630	20I+40J+20K+20N
74	Johan Uilkje Lad	37852	2	3.630	50I+50L
75	Pearl of the Dairy's Joe DeKol	23450	9	3.630	22I+22J+11K+ 33L+11M
76	Butter Boy Mercedes Prince	30139	2	3.630	50I+50M
77	Sir Musser Clyde DeKol	40368	2	3.630	50J+50K
78	Korndyke Abbekerk 3d	49288	6	3.628	33I+17J+17M+33N
79	DeKol 2d's Paul DeKol No. 5	25049	2	3.625	50I+50M
80	Hengerveld Homestead DeKol	93149	2	3.625	50J+50K
81	Hillside Vale	41751	5	3.624	40I+60M
82	Pontiac Korndyke	25982	7	3.623	14I+43J+14K+14L+14N
83	Sir Ybma Spofford Pledge	39074	4	3.623	75J+25M
84	Sir Hengerveld DeKol Ormsby (Twin)	31211	4	3.623	50J+50K
85	King Hengerveld Pondyke	47843	8	3.611	38I+13K+13L+25N+13O
86	Korndyke Butter Boy	38496	2	3.610	50J+50K
87	Prince Ybma Spofford 6th	47135	3	3.610	33I+33K+33L
88	Sir Ormsby Sylark	47010	3	3.607	33I+33N+33O
89	Sir Korndyke Hengerveld DeKol	41266	11	3.606	27I+18J+9K+18L +18M+9N
90	Sir Johanna Piebe	53257	13	3.603	23I+8J+23K+23L+23M
91	King Segis Pontiac Witkop	53918	2	3.600	50J+50L
92	DeKol Spofford Promise	40207	3	3.600	33J+33K+33L
93	Gem Pietertje Paul DeKol 3d	44658	7	3.599	14I+14J+43K+14O+14N
94	Sir Piebe Aaggie Hengerveld	32492	10	3.599	20I+60J+10O+10P
95	Ormsby Korndyke Lad	102469	4	3.598	50J+50L
96	Sir Johanna DeKol Rue	33437	4	3.595	25J+75K
97	Sir Lilith Posch	42682	3	3.593	33I+33J+33N
98	Masterpiece	84099	4	3.590	25J+75K
99	Sir Segis Mutual Walker	80916	4	3.590	25I+50K+25L
100	Rag Apple Korndyke DeKol	67211	4	3.583	50I+25L+25N
101	Sir Clyde	29236	2	3.575	50J+50L
102	Sir Ormsby DeKol	27284	2	3.570	50I+50O
103	Sir Pietertje Korndyke Hengerveld	74982	2	3.570	50J+50L
104	Junior Concordia DeKol	35975	2	3.565	50J+50L
105	Lad of Home Farm	33642	2	3.565	50J+50M
106	King Ormsby	54424	3	3.563	33I+33L+33P
107	Hygeia Veeman Butter Boy	43697	12	3.562	25I+8J+8K+17L+25M +8N+8O
108	Pietj 22d's Woodcrest Lad	39849	2	3.560	50J+50L
109	Jewel Paul	29463	2	3.560	50J+50L
110	Prince Leo Aaltje	61435	3	3.557	33I+33N+33O
111	Sir Challenge Diamond Beauty	57908	3	3.557	67J+33M
112	Pietertje DeKol Paul DeKol	41895	2	3.555	50I+50N
113	Beryl Wayne Veeman	35431	3	3.550	33I+33L+33O
114	Paul Cornucopia America	39904	2	3.550	50J+50L
115	King Pontiac Artis	63994	3	3.547	33J+33K+33L
116	Joseph Prilly	51078	3	3.547	33I+33K+33P
117	Sir Carlotta Pontiac Crorus	45502	4	3.545	25I+25J+25L+25N
118	Downing Johanna Burke DeKol	84472	2	3.545	50J+50M

Performance of the Progeny of Holstein-Friesian Sires for Milk Production.—Continued.

No.	Name	H. B. No.	No. of Daughters	Butter-Fat %	Octiles
119	King Pontiac Shadeland	113938	2	3.545	50J+50M
120	Walker Korndyke Segis	50347	2	3.545	50J+50L
121	Count Aaggie Netherland DeKol	35887	3	3.540	67J+33N
122	Luecke Paul	33289	2	3.540	50J+50N
123	Pietj 22d Son	58314	2	3.540	50J+50L
124	Hartog Paul Burke	49910	3	3.537	67J+33M
125	Segis DeKol Korndyke Prince	31846	2	3.535	50K+50L
126	Brom Bones	35903	4	3.535	75K+25L
127	DeKol 2d's Butter Boy 3d	23260	8	3.535	13I+13J+25K+25L +13M+13O
128	Belle Korndyke Beryl Wayne	32386	2	3.530	50I+50O
129	Parthenea's Sir Henry 2d	24091	2	3.525	50K+50L
130	DeKol 2d's Paul DeKol No. 2	23366	2	3.525	50K+50L
131	Sir Korndyke Pontiac Artis	46391	5	3.524	20I+60L+20N
132	King Segis Hengerveld Vale	60344	8	3.524	13I+25K+13L+38M+13N
133	Star Farm Johanna Lad	45224	11	3.520	45J+9K+9L+18M+9N +9O
134	Oak DeKol Ollie Homestead	85529	3	3.520	33I+33N+33O
135	Earl Korndyke DeKol	24954	7	3.519	29J+14K+43L+14M
136	Sir Winana Beets Segis	52927	6	3.517	17I+17J+17K+33M+17O
137	Sir Ormsby Hengerveld DeKol	31212	14	3.516	21I+21J+7L+21M+7N +7O+14P
138	King Pontiac Champion	53418	20	3.512	15I+20J+10K+20L+ 15M+5N+10O+5P
139	King Koningen DeKol	29813	2	3.510	50K+50L
140	Romeo Aaggie Acme of Riverside	32422	6	3.510	33I+17J+17M+33O
141	Admiral Walker Pietertje	35269	12	3.509	33J+17K+42L+8O
142	Pontiac Hesseltje Korndyke	31438	5	3.508	20J+20K+40L+20M
143	Parkside Spofford Lyons DeKol	58022	2	3.505	50K+50L
144	Wisconsin Bess Mooie DeKol	40248	2	3.505	50J+50M
145	King Pontiac Portia	63895	2	3.505	50J+50M
146	Prince Alcartra Korndyke	88318	5	3.504	20J+20K+40L+20N
147	Johanna Rue Sarcastic Lad	34999	4	3.503	25J+25K+25L+25M
148	Sir Colantha Juliana 2d	98762	2	3.500	50K+50L
149	Johan Wooderest Lad	52145	5	3.500	20J+20K+40L+20M
150	Jewel Paul 13th	58769	3	3.500	33J+33L+33N
151	Wooderest Pietje	35469	2	3.500	50J+50M
152	King Ormsby Parthenea	81639	5	3.500	60J+20M+20P
153	Knight Errant	39566	3	3.497	33I+33L+33O
154	Pride of Maplehurst Roe	44085	2	3.495	50K+50L
155	Sir Johanna Aaggie Posch 4th	72013	2	3.495	50K+50M
156	Colantha Johanna Champion	45674	4	3.495	25I+25K+25L+25P
157	Mooie Fayne DeKol	38505	2	3.490	50K+50L
158	Korndyke Hengerveld Gerben DeKol	50361	3	3.490	33J+33L+33M
159	Lilith Pauline DeKol's Count	28439	3	3.490	33J+33L+33N
160	Dutchland Sir Korndyke Gladi	48121	2	3.490	100L
161	Sir Aaggie Cornucopia Segis	76665	2	3.490	50J+50M
162	Duchess Ormsby Butter King	30199	3	3.487	33J+33K+33N
163	Dutchland Sir Pietertje Hengerveld	48696	3	3.487	33I+33J+33P
164	Sir Longfield DeKol	36380	4	3.485	25K+50L+25M
165	Aaggie Cornucopia 3d's Lilith	34467	5	3.482	20J+40K+20M+20O
166	King Lyons Spofford 3d	75034	2	3.480	50J+50N
167	Mooie Oak DeKol 2d	60278	2	3.480	50J+50M
168	Maplecrest Butter Boy DeKol	94156	2	3.480	50J+50N
169	Colantha 4th's Lad	26940	6	3.478	17J+17K+33L+17M+17O
170	Sir Duke Walker	71158	4	3.478	25J+25K+25L+25O
171	Aralia DeKol Pontiac Segis	112077	2	3.475	50K+50M
172	Sir Kaan Jewel Mercedes	43666	2	3.475	100L
173	Sir Piebe DeKol Ringwood	31215	2	3.475	50K+50M
174	Prince Inka Pietertje DeKol 2d	22699	3	3.470	67K+33N
175	Samuel DeKol	36903	2	3.470	50J+50M

Performance of the Progeny of Holstein-Friesian Sires for Butter-Fat Percentage.—Continued.

No.	Name	H. B. No.	No. of Daughters	Butter-Fat %	Octiles
176	Johanna De Colantha Champion	60574	13	3.468	31J+15K+8L+23M+15N+8O
177	King Pontiac Netherland	50865	2	3.465	50K+50M
178	Segis Pontiac DeKol Burke	97472	5	3.464	20I+20J+40N+20O
179	Paul Rijaneta 2d	25166	3	3.463	33J+33L+33M
180	Spring Farm King Pontiac 6th	103899	5	3.462	20J+20K+40L+20N
181	Sir Korndyke Queen	55993	9	3.461	56J+11M+22O+11P
182	Cor-Will Colantha Paul DeKol	52791	3	3.460	67K+33N
183	King Segis Pontiac Pietertje	48358	4	3.460	25K+50L+25M
184	Korndyke Netherland Wayne DeKol	47306	2	3.460	50I+50O
185	Sir Johanna DeKol Darkness	40871	2	3.460	50I+50P
186	King Segis Pontiac Count	93909	10	3.458	20I+10K+20L+30M+10N+10P
187	Beppo Jewel Lad	30634	3	3.457	67K+33N
188	Fobes Tritomia Mutual DeKol	40534	6	3.455	67K+33N
189	Sir Korndyke Hengerveld DeKol 36th	85968	3	3.453	33J+33L+33N
190	Prince Johanna DeKol	31168	2	3.450	50I+50O
191	Pontiac Hengerveld Parthenea	39972	7	3.450	29I+14M+14N+43P
192	Gem Segis Beets	52297	2	3.450	50J+50N
193	Beauty Pietertje Prince	56435	4	3.448	25I+25K+25N+25O
194	Sunnyside Homestead DeKol	35226	3	3.447	33K+33L+33M
195	Sir Johanna Bonheur Fayne	45671	7	3.447	14J+43K+14M+29N
196	Rag Apple Korndyke 8th	73416	3	3.447	33J+33K+33P
197	Aaltje Salo Mercedes DeKol Prince	39357	8	3.445	25J+25K+25M+13N+13P
198	Minnie Hark Prince Korndyke	41660	2	3.445	50J+50N
199	King Segis Pontiac	44444	5	3.444	60K+20M+20N
200	DeKol Butter Boy Prince	30369	4	3.443	75L+25M
201	Beryl Wayne Korndyke of Riverside	32322	5	3.442	60K+20L+20P
202	Virginia Korndyke Butter Boy	128445	2	3.440	50K+50M
203	Paul Mechthilde DeKol	22233	4	3.438	25I+50N+25P
204	Pietj Burke	58313	4	3.438	25I+25K+25N+25O
205	King Pontiac Ruby Burke	58941	5	3.432	40J+20L+20M+20O
206	Beauty Walker Pietertje King	84482	3	3.430	33J+33M+33N
207	Elmwood Sir Hengerveld Segis	71527	2	3.430	50K+50N
208	Small Hopes Korndyke DeKol	32260	2	3.430	100L
209	Dutchland Colantha Sir Inka	50999	19	3.427	21J+5K+32L+21M+16N+5O
210	King Segis Pontiac Alcartra	79602	2	3.425	50L+50M
211	Chief of Crown Hill	39314	2	3.420	50K+50M
212	Major Spofford Corona	42729	2	3.420	50K+50N
213	King Pontiac Dione	82505	11	3.420	9I+9J+9K+9L+27M+18N+9O+9P
214	The Milk & Butter King 2d	48846	2	3.420	50K+50N
215	King Walker	40358	8	3.418	25J+13K+13L+25M+13N+13O
216	Homestead Girl DeKol Sarcastic Lad	32558	17	3.417	12J+12K+29L+24M+12N+12O
217	Wit Duchess Gem	31208	2	3.415	50K+50N
218	Judge Beets Segis	51511	2	3.405	50J+50O
219	Redbud Cornucopia DeKol King	93229	5	3.404	20J+20K+20M+40O
220	Spring Farm King Pontiac 8th	114319	3	3.403	67L+33N
221	Johanna McKinley Segis	44367	2	3.400	50L+50M
222	Agatha Netherland Pietertje	26980	2	3.400	50L+50M
223	Clothilde Chief	20994	2	3.400	100M
224	Johanna DeKol's Lad 2d	60360	2	3.400	50L+50M
225	Korndyke Queen DeKol's Prince	26025	9	3.399	11J+11K+22L+44M+11P
226	King Segis Hengerveld	51523	3	3.397	33K+33L+33O
227	Sir Homestead Posch DeKol	37314	9	3.396	33J+11K+11M+11N+22O+11P

Performance of the Progeny of Holstein-Friesian Sires for Butter-Fat Percentage.—Continued.

No.	Name	H. B. No.	No. of Daughters	Butter-Fat %	Octiles
228	Woodcrest Hengerveld DeKol	46514	2	3.395	50K+50N
229	Jessie Fobes Tritomia Duke	32254	5	3.394	20J+20K+20L+40O
230	Homestead Jr. DeKol	28400	3	3.393	33J+33L+33P
231	Quirinus Cornucopia	60751	6	3.392	17J+17K+17L+17M +17N+17P
232	Aaggie Sir Ormsby 2d	54001	2	3.390	50K+50N
233	Prince Leila DeKol	29358	3	3.390	33I+33M+33P
234	Segis Hengerveld Johanna	76663	3	3.387	33K+67N
235	DeKol Paul Cornucopia King	71071	2	3.385	50K+50O
236	Lorena Korndyke	81497	2	3.385	100M
237	Manor DeKol Wayne	33894	4	3.383	25K+25L+25M+25O
238	Prince Gelsche Walker	81663	6	3.383	17J+17K+17L+33N+17P
239	Prince Pietertje Beryl	46977	3	3.383	33K+67N
240	Pietertje Hengerveld Sir Korndyke	60966	8	3.383	13J+25K+25L+13M+25P
241	Duke Fobes	60047	5	3.382	60L+40N
242	Oakland Paul Beets Burke	53309	2	3.380	50J+50P
243	Tidy Abbekerk Prince	37770	5	3.378	20J+20K+20L+20N+20P
244	Paul Piebe DeKol	32059	3	3.373	33K+33M+33N
245	Piersma Albina Segis Lad	75361	5	3.372	80L+20O
246	Korndyke Prince Grace DeKol	32655	2	3.370	50K+50O
247	Sir Mercedes DeKol Pet	34205	2	3.370	50K+50N
248	Hazelwood Korndyke Gerben	98063	2	3.365	50L+50N
249	Sir Johanna DeKol	25467	14	3.364	7J+7K+14L+29M+29N +7O+7P
250	Gudultje Gerben Sir Fobes	42183	4	3.360	25L+50M+25N
251	Sir Urmagel Burke	58219	5	3.360	20I+20L+20N+40O
252	Minnie Sandes 2d's Sir Piebe DeKol	29500	4	3.360	50K+25M+25P
253	Pontiac Arcas	41484	2	3.355	50L+50N
254	Hengerveld Butter Boy DeKol	44543	3	3.353	33N+33K+33O
255	Ladoga King Veeman DeKol	43496	3	3.353	33K+33M+33O
256	Sir Jolie DeKol	28633	2	3.350	50L+50N
257	Dutchland Sir Pontiac Rag Apple	47282	4	3.350	25J+25K+50O
258	Canary Piebe DeKol	35188	2	3.345	50M+50N
259	Prince De Haan Butter Boy	35074	2	3.345	50K+50O
260	Segis Pontiac Pauline Count	57188	2	3.345	100M
261	White Segis DeKol	78027	2	3.345	50K+50O
262	Johanna de Pauline 2d's Lad	28301	4	3.343	25K+50M+25O
263	Sunny Jim	38883	2	3.340	50K+50O
264	Mechthilde DeKol Pietertje Paul	29548	2	3.340	100M
265	Sir Hengerveld Model Johanna	40338	10	3.339	10I+10J+10K+10L+ 10N+30O+20P
266	Iowana Lad	70753	3	3.337	33K+33M+33O
267	Captain Pietertje Barber	41099	2	3.335	50L+50N
268	Hollywood Rocelia Palmyra	121546	2	3.335	50L+50N
269	North Star Longfield Sir Beets	97493	2	3.335	50M+50N
270	Prince Beauty Pietertje Hartog	45074	3	3.333	33L+33M+33O
271	Prince Homestead DeKol	34944	6	3.332	17L+50M+17N+17O
272	Tulip Hengerveld DeKol	41562	3	3.330	33J+67O
273	Sir Gerben Pietertje	40214	2	3.330	50L+50O
274	Gem Pietertje Paul DeKol	27282	2	3.330	50K+50O
275	Mercedes Cornucopia Count	44742	2	3.330	50M+50N
276	Emblagaard Tritomia Homstead	62924	12	3.329	17K+25L+17M+8N +25O+8P
277	Colantha Johanna Lad	32481	8	3.326	13I+25K+13N+25O+25P
278	Star Farm Inka Count	53247	2	3.320	50J+50P
279	Jantha Sir Posch	33957	2	3.320	50K+50O
280	Korndyke Abbekerk	34503	4	3.320	25K+50N+25O
281	Butter Boy Model DeKol	37222	2	3.315	50L+50N
282	Carlotta 2d's Sir Parthenea	454W. H.F.A.	2	3.315	50M+50N

Performance of the Progeny of Holstein-Friesian Sires for Butter-Fat Percentage.—Continued.

No.	Name	H. B. No.	No. of Daughters	Butter-Fat %	Octiles
283	Count King	59660	2	3.315	50M+50N
284	King Pietertje Cloverdale	69686	4	3.313	25K+25M+25N+25P
285	King Pietertje Hengerveld Ormsby	107790	2	3.310	50M+50N
286	Hengerveld Soldene Washington	107891	3	3.310	33J+67O
287	Gerben Boelyn	28243	2	3.310	50L+50O
288	Tirania Lady Colantha Hero	35250	2	3.310	50L+50O
289	Sir Korndyke Hengerveld Canary	53825	6	3.308	17J+33L+33O+17P
290	Tina Clay Johanna	38214	6	3.307	17K+17L+50N+17O
291	St. Paul DeKol	31338	3	3.307	33K+33L+33P
292	Paul Beets DeKol	22235	3	3.307	33K+33M+33P
293	Gilbert Pauline Paul DeKol	27796	2	3.305	50L+50O
294	Rose Hall Pontiac Pietertje	59959	2	3.305	50L+50O
295	Duke Segis Inka Korndyke	49722	7	3.304	14J+14K+14L+14M+14O+29P
296	Alcartra Polkadot Corrector	30624	13	3.301	23K+8L+15M+23N+23O+8P
297	Woodcrest Gordon Fayne	97208	4	3.300	25K+25M+25N+25P
298	Johanna Clothilde 3d's Clyde	30559	7	3.300	14J+57M+29P
299	Wachusett Creamelle George	41803	2	3.300	50M+50N
300	Aaggie Cornucopia Pauline Count 7th	44758	3	3.297	33L+33M+33O
301	Jetine's Echo's Mercedes Prince	22499	2	3.295	50K+50P
302	Sir Lilith Pauline Johanna	52527	2	3.295	50M+50N
303	Fobes DeKol Homestead	55736	2	3.290	50L+50P
304	Prince Segis Johanna Korndyke	97224	2	3.290	50M+50N
305	Hollins Hamilton	55819	2	3.290	50M+50O
306	Sir Pietertje Lass DeKol	94292	5	3.286	20I+20L+20O+40P
307	Pontiac Hengerveld DeKol	29027	5	3.284	40M+40N+20O
308	Woodcrest Tehee	74219	13	3.283	8J+8K+23M+31N+23O+8P
309	Sir Fayne Concordia	35227	8	3.283	25K+13L+13N+25O+25P
310	Sir Aaggie DeKol Netherland	29588	6	3.282	17J+17M+50N+17P
311	Jessie Fobes Mutual	55732	5	3.282	40L+20P+20N+20O
312	Pontiac Burke	33979	2	3.280	50M+50O
313	Christmas Pontiac King	52983	3	3.280	33M+33N+33O
314	Parthenea Sarcastic	42448	4	3.280	25I+25L+50P
315	Sir Ormsby Johanna DeKol	37689	2	3.280	50L+50O
316	Sir Johanna Vernon DeKol	37409	2	3.275	50M+50O
317	Johanna DeKol's Lad	26938	20	3.275	10J+5K+20L+10M+20N+15O+20P
318	Sir Von Harlingen Vernon DeKol	29876	2	3.275	50M+50O
319	Sir Johanna Colantha Concordia	53059	4	3.273	25L+50N+25O
320	DeKol 2d's Mutual Paul	25700	2	3.270	50M+50O
321	Johanna Colantha's Lad	28296	4	3.270	25K+50N+25P
322	Sir Johanna DeKol 19th	64143	4	3.270	50M+25N+25O
323	Plum Lad	59272	2	3.270	50L+50O
324	Cornucopia Pontiac Johanna Lad	48355	2	3.265	50L+50O
325	Sir Henry Netherland of Hollins	30674	6	3.263	17K+17M+17N+33O+17P
326	Sir Cornucopia Prince	48663	6	3.262	17K+33M+17N+33P
327	Sir Walker Segis	50672	12	3.261	17K+17M+25N+33O+8P
328	Pride DeKol of Wayside	45805	2	3.260	100N
329	Piebe Longfield DeKol	51317	4	3.258	25M+50N+25O
330	Homestead Masterpiece Aaggie	59682	6	3.258	17L+17M+17N+50O

Performance of the Progeny of Holstein-Friesian Sires for Butter-Fat Percentage.—Continued.

No.	Name	H. B. No.	No. of Daughters	Butter-Fat %	Octiles
331	Paul DeKol 3d	22894	2	3.255	50M+50O
332	Mutual Piebe DeKol	44554	8	3.255	50K+13O+38P
333	Piebe Champion	60577	5	3.254	20J+20N+40O+20P
334	Prince Nudine DeKol 2d Aaggie	62483	2	3.250	50M+50O
335	Anselmo	41866	2	3.250	50M+50O
336	Aaggie Cornucopia Johanna Lad Jr. 5th	60529	4	3.250	50L+25M+25P
337	Sir Prilly Segis	51510	3	3.250	67N+33O
338	Johanna Bonheur Sir Fayne	46595	2	3.250	50M+50O
339	DeKol Burke	22991	8	3.248	13K+13L+13M+13N +25O+25P
340	Butter Boy Hengerveld DeKol	24937	3	3.247	33J+67P
341	Prince Pietertje Maid	42033	7	3.246	43K+29O+29P
342	Canary Mercedes Pietertje Hartog 6th	78123	2	3.245	50N+50O
343	DeKol Clothilde Artis	28340	4	3.245	25M+25N+50O
344	Anual's Paul DeKol	26167	2	3.245	50M+50O
345	Sarcastic Lad	23971	10	3.241	10J+20L+10M+ 30N+30P
346	King Segis Beets	48702	3	3.240	33K+33N+33P
347	Sir Johanna Ruth Fayne	53055	2	3.240	50M+50P
348	Hollins Harlem	49795	2	3.240	50M+50O
349	Manor DeKol's Plum	24777	2	3.240	100N
350	King Soldene Butterfly	91668	2	3.235	50L+50N
351	Beryl Wayne's Son	30413	2	3.235	50M+50O
352	Ignaro DeKol	23538	12	3.234	8K+17L+8M+42N+25P
353	Yakima Cornucopia	36220	3	3.233	33L+33M+33P
354	Linden Butter Boy Pietertje	54120	3	3.230	33M+67O
355	Gerster 7th's Hero	35165	4	3.230	25L+50O+25P
356	King Segis Pontiac Emperor	72287	2	3.230	50M+50O
357	Sir Johanna Genoora	53399	2	3.225	50M+50O
358	King Palmyra Fayne	72099	2	3.220	50N+50O
359	Gordon Glen Hengerveld DeKol	52410	3	3.217	67N+33O
360	May Paul DeKol	31957	2	3.215	50M+50P
361	Sir Piebe Johanna Sarcastic	37094	4	3.215	25K+50O+25P
362	Pontiac Cornucopia	38977	2	3.215	50N+50O
363	DeKol Creamelle Pontiac Butter Boy	48498	4	3.208	25M+25N+50O
364	Alma Prince Jewel	32731	3	3.207	33L+33N+33P
365	Junior DeKol (Twin)	30830	2	3.205	50K+50P
366	Johanna Colantha 2d's Sir Fayne	45998	2	3.205	50N+50O
367	King Prilly Pietertje	46212	2	3.205	50L+50P
368	North Star Johanna DeKol Duke	52163	2	3.205	50N+50O
369	Johanna Bonheur Champion	94984	2	3.195	50M+50P
370	Lord Indi DeKol	29882	2	3.195	50M+50P
371	Aaggie Grace Sir Butter Boy	62239	3	3.190	33M+33N+33P
372	Beryl Wayne DeKol Paul Pietertje	40663	2	3.190	100O
373	Paul Frenesta DeKol	41206	20	3.189	5K+15L+15M+15N+ 10O+40P
374	Upland Johanna DeKol	57256	2	3.185	50M+50P
375	Lakeside Model Alban	71013	2	3.180	50N+50O
376	Hazelwood Sir Ormsby	77572	2	3.180	50M+50P
377	Sir DeKol Ruth	47341	2	3.180	50M+50P
378	Johanna Colantha Sarcastic Lad	38402	9	3.177	11K+22L+33P+33O
379	Johanna Fayne Hartog	65981	2	3.175	50N+50P
380	Aaggie Cornucopia Johanna Lad	32554	3	3.173	33N+67O
381	King of the Black and Whites	83354	2	3.170	50N+50O
382	Sir Forrisy DeKol Paul	40492	4	3.165	50N+25O+25P

Performance of the Progeny of Holstein-Friesian Sires for Butter-Fat Percentage.—Continued.

No	Name	H. B. No.	No. of Daughters	Butter-Fat %	Octiles
383	Paul Calamo Korndyke 3d	60710	2	3.165	50N+50P
384	Sadie Vale Concordia's Paul DeKol 3d	33661	2	3.160	100O
385	Sir William Prince	37226	3	3.160	33N+67O
386	Johanna Rue 2d's Paul DeKol	21724	5	3.152	40M+40O+20P
387	Sir Johanna Fayne	42147	18	3.150	6I+22L+6M+11N+11O+44P
388	Fayne Sir Mutual DeKol	38243	3	3.143	33N+33O+33P
389	Oak DeKol 2d Homestead Fobes	65750	3	3.140	67O+33P
390	Houwtje Portage Paul DeKol	39156	2	3.135	50M+50P
391	Mutual Friend DeKol Albrice	38079	5	3.134	20L+20N+60P
392	Pontiac Cronus	28835	4	3.133	25M+25N+25O+25P
393	Pabst Pontiac Champion	105106	2	3.125	50O+50P
394	Woodcrest DeKol Burke	40718	2	3.125	50M+50P
395	Hengerveld DeKol Tromp	81405	3	3.123	67N+33P
396	Plum Hengerveld DeKol	27141	2	3.120	50M+50P
397	Oak Grove Errant	47898	2	3.120	100O
398	Joe Pride Aaggie DeKol	66417	2	3.120	50N+50P
399	Aaggie Clothilde Bawn DeKol	33207	3	3.120	33N+33O+33P
400	Sir College Cornucopia	59755	2	3.120	50M+50P
401	Piebe Laura Ollie Homestead King	110474	3	3.117	33N+67P
402	Johanna Sarcastic Paul	30551	2	3.115	50L+50P
403	Sir Concordia Korndyke	75012	5	3.110	20N+60O+20P
404	Pietertje Hengerveld Mercena DeKol	42381	2	3.110	50O+50P
405	The Milk and Butter King	41114	2	3.105	50O+50P
406	Sir Hubbard Pietertje	48557	2	3.100	50N+50P
407	Inka Mechthilde Prince	29214	2	3.100	50N+50P
408	Sir Carlotta Pontiac	38652	3	3.097	33L+67P
409	King of the Hengerveld	44465	2	3.095	50N+50P
410	Beechwood Sir Josephine	26734	2	3.090	50N+50P
411	Sir Johanna Friend Clothilde	26937	3	3.087	33L+67P
412	Sir Beets DeKol Ormsby	46763	2	3.085	50O+50P
413	Colantha Hartog Pietertje	96076	2	3.080	50P+50O
414	Sir Pontiac Korndyke Pietertje	53618	2	3.075	50O+50P
415	King Veeman DeKol	36819	3	3.070	33N+67P
416	Pontiac Cornucopia Coronis	51148	2	3.065	100P
417	Paul Hengerveld DeKol Concordia	36632	2	3.065	50O+50P
418	Sir Beets Cornucopia Netherland	38460	4	3.065	25N+75P
419	Riverside King	49207	2	3.055	50K+50P
420	Sir Mooie Oak DeKol	41220	3	3.053	33M+67P
421	Almeda Luecke 2d's Son	30266	2	3.050	50O+50P
422	Sir Vale Daisy DeKol Paul	40547	2	3.050	50O+50P
423	Iowa Ormsby Duke	66092	2	3.040	50O+50P
424	Butter Boy Sir Mechthilde	37302	3	3.037	33O+67P
425	Arcady Segis Hengerveld Wayne	75304	4	3.023	50O+50P
426	Creamelle Aaggie Taurus	80551	2	3.020	50O+50P
427	Sir Aaltje Posch	31789	2	3.020	50O+50P
428	Aaggie Cornucopia Johanna Lad Jr.	36974	9	3.017	11L+11N+33O+44P
429	Wit Segis Abbekerk	85556	2	3.015	100P
430	Duke Spencer Lyons	45652	2	3.010	50O+50P
431	Leland Sarcastic	42451	2	3.010	50N+50P
432	Cornucopia Monarch Vale	59156	2	3.005	50N+50P
433	Nieta Pauline Duke	40386	2	3.000	100P
434	Dichter Calamity Segis DeKol	59219	2	2.990	50N+50P
435	Mutual Paul Pietertje DeKol	35911	2	2.990	100P
436	Inka Jupiter Jr.	43113	2	2.990	50N+50P
437	Johanna Rue Lad	34989	2	2.980	100P

Performance of the Progeny of Holstein-Friesian Sires for Butter-Fat Percentage.—Concluded.

No.	Name	H. B. No.	No. of Daughters	Milk	Octiles
438	Lord Nudine DeKol	35639	3	2.970	100P
439	Count Pietertje Hengerveld DeKol	41757	2	2.960	100P
440	Spring Brook Hengerveld Parthenea	68946	4	2.960	250+75P
441	Cedar Lawn Sir Johanna	104002	3	2.957	100P
442	Segis Longfield Homestead	75627	2	2.955	100P
443	Tehee Lilith Pauline DeKol	36636	2	2.950	500+50P
444	Duke Ormsby DeKol Creamelle	63578	2	2.925	100P
445	Sir Jolie Johanna	36664	3	2.923	100P
446	Madge Prince Hartog	56632	2	2.905	100P
447	Missouri Chief Josephine Lad	70857	4	2.903	25N+75P
448	Emblagaard Prince	80596	4	2.893	100P
449	Riverview Hengerveld	93371	2	2.820	100P

There are 449 sires with two or more year test daughters recorded in table 14. The range of the average butter-fat percentage for all tested sires is from 4.503 per cent to 2.820 per cent. Of the 449 sires King Hengerveld Aaggie Fayne's daughters head the list with the highest average butter-fat test. The sires whose daughters' tests are lowest are those toward the end of the table. These include the animals Missouri Chief Josephine Lad, Emblagaard Prince and Riverview Hengerveld.

Among those sires with a good number of daughters with a high average test might be mentioned the bulls King Mead of Riverside, Pontiac Aaggie Korndyke, King of the Pontiacs and Aaggie Cornucopia Pauline Count 13th. Of these bulls the sire, King of the Pontiacs, is to be most commended for the high average of so many daughters.

A thing which is encouraging to the man interested in the progress of the breed is the fact that there are many more daughters of the bulls siring high test daughters than there are of the bulls siring low test daughters. Thus the first fifty bulls siring high test daughters contained 219 daughters. The last fifty sires of the lowest testing daughters have only 129 recorded daughters. This would make it seem as though the breeders were discarding the bulls as sires whose daughters were low testing. There is unfortunately some possibilities of error in this conclusion due to the fact that all the bull's daughters are

not recorded. Thus it may well be thought that sires of the poorer testing daughters do not have some of those daughters in the advanced registry only because those daughters cannot make the requirements for entry. In such a case the same general diminution of the numbers of the low test daughters of the low average sires would be observed.

Table 14 is, of course, most useful as a reference table where the breeder selects the facts about the particular sire in which he is interested. It may be of some value to examine table 14 in connection with the information contained in table 5 to determine what sires have daughters significantly above the mean or average butter-fat percentage of all the Holstein-Friesian advanced registry cows.

The same plan as that used for table 6 is followed throughout this discussion. The probable errors for the butter-fat percentages are tabled in table 5 for the different numbers of daughters. If a sire has daughters which are on the average 3 times this probable error greater than the mean butter-fat percentage of all Holstein-Friesian cows the difference is considered significant and is recorded as such. For those sires whose daughters' butter-fat percentage differs from the average of the advanced registry cows 4 times to 6 times the probable error, the record is made as quite significant or markedly significant. The sires of daughters with significantly higher butter-fat percentage than the rest of the breed are given below. The number given is that in the first column of table 14. This is followed by the sire's name and the significance of the record. When the sire also was in the list of sires whose daughters were significantly higher or lower in their milk yield than the rest, the number of table 6 is given in parenthesis after the name. The sire's name is also put in *italics*. Those which were significantly higher were indicated by the plus sign (+). Those significantly lower were indicated by the minus sign (—).

1	*King Hengerveld Aaggie Fayne*	Markedly significant	(+1)
2	Duchess Ormsby Prince	Quite significant	
3	Sir Inka DeKol Chief	Quite significant	
4	McKinley Hengerveld DeKol	Significant	
5	Kalmuck Skylark Johanna	Significant	
6	King Beauty Pietertje DeKol	Significant	
7	King Mead of Riverside	Markedly significant	
8	*Friend Hengerveld DeKol Butter Boy*	Significant	(+22)

9	*Homestead Crown Prince DeKol*	Significant	(—427)
10	Maple Crest Pontiac Hartog	Significant	
11	*Pontiac Aaggie Korndyke*	Markedly significant	(+63)
13	Homestead Hengerveld Crown DeKol	Significant	
14	Prince Ormsby Mercedes DeKol	Significant	
15	*Duchess Ormsby Piebe Burke*	Significant	(—410)
18	Zady Bergsma Butter Boy	Significant	
23	Juliana King of Riverside	Significant	
24	*King of the Pontiacs*	Markedly significant	(+80)
26	Aaggie Cornucopia Pauline Count 13th	Significant	
30	*Paul Cornucopia Mercedes Aaggie*	Significant	(—385)
44	Canary Paul	Significant	
58	*Sir Pietertje Ormsby Mercedes*	Significant	(+88)
90	*Sir Johanna Piebe*	Significant	(+68)

Four sires have enough daughters on which the average butter-fat percentage is based and these daughters' average butter-fat percentage is sufficiently more than the mean of the breed to make it entirely probable that their average is markedly higher than the breed's average. These four sires are King Hengerveld Aaggie Fayne, King Mead of Riverside, Pontiac Aaggie Korndyke and King of the Pontiacs. The last three of these sires have a good many daughters. Curiously enough these daughters are not all high testers as may be seen in the octile column of table 14. Of these four sires two, Pontiac Aaggie Korndyke and King of the Pontiacs, are by the same sire, Pontiac Korndyke. This sire had 4 other sons with year test daughters. The other sons did not on the whole do so well as did Pontiac Aaggie Korndyke or King of the Pontiacs.

The bulls who sired daughters of significantly lower butter-fat test than the mean of the general population are listed below. These bulls to be so listed must have their daughters' average butter-fat percentage lower than the mean of the advanced registry cows by at least 3 times the probable error. The meaning of the different columns is the same as that of the preceding list.

449	Riverview Hengerveld	Significant	
448	*Emblagaard Prince*	Significant	+23
447	Missouri Chief Josephine Lad	Significant	
446	Madge Prince Hartog	Significant	
445	*Sir Jolie Johanna*	Significant	+24
444	*Duke Ormsby DeKol Creamelle*	Significant	+6
443	Tehee Lilith Pauline DeKol	Significant	

442	Segis Longfield Homestead	Significant	
441	Cedar Lawn Sir Johanna	Significant	
440	Spring Brook Hengerveld Parthenea	Significant	
439	Count Pietertje Hengerveld DeKol	Significant	
438	*Lord Nudine DeKol*	Significant	—432
428	*Aaggie Cornucopia Johanna Lad Jr.*	Quite significant	+47
425	Arcady Segis Hengerveld Wayne	Significant	
424	Butter Boy Sir Mechthilde	Significant	
420	Sir Mooie Oak DeKol	Significant	
418	Sir Beets Cornucopia Netherland	Significant	
403	*Sir Concordia Korndyke*	Significant	+31
391	Mutual Friend DeKol Albrice	Significant	
387	*Sir Johanna Fayne*	Significant	+77
378	*Johanna Colantha Sarcastic Lad*	Significant	+68
373	Paul Frenesta DeKol	Significant	

There are 22 sires whose daughters are lower in their butter-fat test than are the cows of the breed taken as a whole. Of these 22 sires only one has his daughters' butter-fat percentage lower than the rest of the breed by an amount sufficient to be sure that it was significant. This sire is Aaggie Cornucopia Johanna Lad Jr.

When the numbers of inferior sires are compared with those whose daughters were higher in their butter-fat percentage than the rest of the breed it is found that there were 22 of each. There is then an equal chance of choosing a good sire or of choosing a poor sire. The chance of selecting a sire for butter-fat percentage when selecting from the breed as a whole whose daughters will be only average in their butter-fat percentages is much better than of choosing either a good or poor sire when selecting from the breed as a whole.

If the numbers of sires with daughters which are significantly better than the general Holstein-Friesian advanced registry cow in their milk yield are compared with those sires the daughters of which are significantly better in their butter-fat percentage it is found that there are 48 sires in the first group to 22 in the second group. In a similar comparison of those sires which have daughters with a significantly low milk yield compared with those which have daughters with a significantly low butter-fat percentage it is found that they stand in the ratio of 29 to 22. Clearly the sires whose daughters are significantly higher in their milk yield are in the majority. The difference seems significant both with those sires which sired

daughters low in their milk yield and with those the daughters of which were high or low in their butter-fat percentage. This difference would seem to indicate that greater attention is being devoted to the increase of milk yield than is being devoted to increase of the butter-fat percentage.

Four classes of sires are found in all the breeds of dairy cattle. One class of sires have daughters with a high milk yield and a high butter-fat test for their milk. This class is the most desired and most sought after by all breeders. The second class of sires have daughters with a high milk yield but a low butter-fat percentage. The third class of sires have daughters low in their milk yield but high in their butter-fat percentage. The fourth class of sires have daughters low in both milk yield and butter-fat percentage.

The lists of sires given after tables 6 and 14 give those sires which have daughters significantly higher or lower than the rest of the breed in their milk yield or butter-fat percentage. Between these two extremes are included the greater class of mediocrity. The sires to which belong those daughters which were significantly lower or higher than the rest in milk yield will not necessarily belong to that group of sires which have daughters significantly higher or lower in their butter-fat percentage. Examination of these lists for those which do occur, which belong outside the mediocrity, for both of these attributes, milk yield and butter-fat percentage, marks those sires indicated below as worthy or inferior according to the performance of their daughters.

In the class of sires whose daughters had a significantly higher milk yield and butter-fat percentage than the rest of the breed were King Hengerveld Aaggie Fayne, Friend Hengerveld DeKol Butter-Boy, Pontiac Aaggie Korndyke, King of the Pontiacs, Sir Pietertje Ormsby Mercedes and Sir Johanna Piebe. These sires would on the record of their daughters alone be considered some of the best of the breed.

In the class of sires whose daughters had a significantly high milk yield but a significantly low butter-fat percentage are Emblagaard Prince, Sir Jolie Johanna, Duke Ormsby DeKol Creamelle, Aaggie Cornucopia Johanna Lad, Jr., Sir Concordia Korndyke, Sir Johanna Fayne, Johanna Colantha Sarcastic Lad.

These sires depend for their worth on the type of dairy farming the owner is doing.

In the class of sires whose daughters had a significantly low milk yield but a significantly high butter-fat percentage are Homestead Crown. Prince DeKol, Duchess Ormsby Piebe Burke, and Paul Cornucopia Mercedes Aaggie. These sires, likewise, depend for their worth on the type of dairy farming in which the owner is engaged.

Only one sire is in the class whose daughters are significantly low in both their milk yield and butter-fat percentage. This sire is Lord Nudine DeKol. Such a sire is likely to prove a disappointment to its owner.

These two lists, the first representing the better sires and the second the inferior sires as measured by their daughters' average butter-fat percentage, furnish data of value in assisting to determine what may be the best breeding practices. The information obtained has the same relation to butter-fat percentage that the analysis of the previous like information on milk yield had to milk yield. It is, of course, necessary to treat these data separately as it has been shown that milk yield and butter-fat percentage are so slightly correlated in the Holstein-Friesian breed as to be almost independent quantities.

The information which appears to be particularly desirable is:

(1) the real significance of inbreeding.
(2) the real significance of relationship between the sire and dam of a given sire.
(3) the real significance of animals of supposed transcendent merit within the pedigree of a bull as a measure of that bull's worth.

Four generation pedigrees have been worked out for the sires in these butter-fat percentage lists. The amount of inbreeding for the four generations has been determined for each sire. This inbreeding is defined the same as it was for the lists analyzed for milk yield, v.s. the condition or state in which the animal in question has fewer different ancestors than the maximum number possible. This amount of inbreeding for each sire as determined for each generation is recorded as Z_1, Z_2, Z_3, for the second, third and four generations of the pedigree of each

sire, in tables 15 and 16. The total amount of inbreeding for the whole pedigree when referred to the total possible amount of inbreeding as shown by the brother and sister mating is recorded as Z_{T_3} in the fourth column of these tables.

Relationship between the parents of the given sire is defined as in the preceding section v.s. the number of common ancestors possessed by the parents. The percentage of these common ancestors to the total possible number of ancestors measure the degree of relationship. This is given for each sire in the columns, with heading K_2, K_3 and K_4 for the second, third and fourth generation. Table 15 gives this information for those sires whose daughters were significantly higher than the rest of the breed in the butter-fat percentage of their milk.

TABLE 15.

Ancestral Analysis of the Pedigrees of the Bulls which Sired Significantly High Butter-Fat Testing Daughters.

No.	Name of Sire	Registry No.	Z_1	Z_2	Z_3	Z_{T_3}	K_2	K_3	K_4
1	King Hengerveld Aaggie Fayne	56635	0	0	0	0	0	0	0
2	Duchess Ormsby Prince	25796	0	0	12.5	5.9	0	0	12.5
3	Sir Inka DeKol Chief	53393	0	0	6.3	3.0	0	0	12.5
4	McKinley Hengerveld DeKol	51505	0	0	12.5	5.9	0	0	12.5
5	Kalmuck Skylark Johanna	48832	0	0	0	0	0	0	0
6	King Beauty Pietertje DeKol	50758	0	0	0	0	0	0	0
7	King Mead of Riverside	50290	0	0	0	0	0	0	0
8	Friend Hengerveld DeKol Butter Boy	29393	0	12.5	25.0	17.7	0	25.0	37.5
9	Homestead Crown Prince DeKol	25865	0	12.5	12.5	10.0	0	25.0	25.0
10	Maple Crest Pontiac Hartog	62178	0	12.5	12.5	10.0	0	25.0	25.0
11	Pontiac Aaggie Korndyke	38291	0	0	0	0	0	0	0
13	Homestead Hengerveld Crown DeKol	26345	25.0	37.5	43.8	50.0	50.0	75.0	75.0
14	Prince Ormsby Mercedes DeKol	47008	0	0	12.5	10.0	0	0	12.5
15	Duchess Ormsby Piebe Burke	29328	0	0	6.3	3.0	0	0	12.5
18	Zady Bergsma Butter Boy	28504	0	0	6.3	3.0	0	0	0
23	Juliana King of Riverside	38446	0	0	6.3	3.0	0	0	12.5
24	King of the Pontiacs	39037	0	0	0	0	0	0	0
26	Aaggie Cornucopia Pauline Count 13th	44293	0	0	6.3	3.0	0	0	0
30	Paul Cornucopia Mercedes Aaggie	94884	0	0	12.5	5.9	0	0	12.5
44	Canary Paul	48328	0	0	6.3	3.0	0	0	0
58	Sir Pietertje Ormsby Mercedes	44931	0	0	0	0	0	0	0
90	Sir Johanna Piebe	53257	0	0	12.5	5.9	0	0	12.5
	Mean		1.14	3.41	8.82	6.33	2.27	6.82	11.93

There are 22 sires included in this table. Of this number one, Homestead Hengerveld Crown DeKol, was inbred in the second generation. In the third generation 4 sires showed some

inbreeding and in the fourth generation 15 sires showed inbreeding. Converted into terms of the total number of sires there were 4.5 per cent inbred in the second generation, 18.1 per cent inbred in the third generation and 68.1 per cent in the fourth generation. The number of inbred sires in this list compares favorably with that for those sires whose daughters were high milk producers as given in table 7. Thus, there were inbred to some degree in the second generation 4.5 per cent of the sires whose daughters' butter-fat test was high, against 4.1 per cent of the sires whose daughters' milk yield was high. In the third generation the ratio stood 18.1 to 20.8 per cent; and in the fourth generation the ratio is 68.1 to 62.2 per cent. The conclusions may be drawn that the numbers of inbred sires siring high milk producing daughters and the numbers of inbred sires siring high butter-fat testing daughters are proportionately equal.

There is one sire which displays kinship between his sire and dam in the second generation. In the third generation 4 sires have their sires and dams related. In the fourth generation 14 sires have their sires and dams related. In terms of the total number there were 4.5 per cent of the sires which displayed kinship in the second generation, 18.1 per cent in the third generation and 54.5 per cent in the fourth generation. Those sires whose daughters' butter-fat percentage was high had a greater percentage of their number with related sire and dam than did those sires whose daughters' milk yield was above the average.

Turning now to the actual amounts of inbreeding it is found that the amount of inbreeding ranges from 0 to 25.0 per cent for the different sires in the second generation, 0 to 37.5 for the third generation and 0 to 43.8 per cent for the fourth generation. As compared with the continued brother and sister mating the inbreeding ranged from 0 to 50.0 per cent of the total possible amount for the four generations. The average amount of inbreeding for the 22 sires in the second generation was 1.14 per cent; in the third generation 3.41 per cent and in the fourth generation 8.82 per cent. The average total inbreeding for the whole four generations was 6.33 per cent.

This inbreeding compares quite favorably in its amount with the average amount of inbreeding displayed by the sires whose daughters' milk production was significantly large. The average inbreeding coefficients of these two groups for the sec-

ond, third and fourth generations are 1.14 to 1.04; 3.41 to 3.12; 8.82 to 8.74 and 6.33 to 6.52 where the amount of inbreeding of the sires whose daughters are high testers is placed first.

The amount of kinship between the sire and dam of the sires whose daughters are significantly high butter-fat testers ranges from 0 to 75 per cent of the total possible amount for the fourth generation. The average amount for the second generation for all of the sires is 2.27 per cent, for the third generation 6.82 per cent and for the fourth generation 11.93 per cent. This amount of kinship for the sires whose daughters' butter-fat percentage is high is approximately the same as that for the sires whose daughters' milk yield is high and nearly twice that for the sires whose daughters' milk yield is low. Too much stress should not be laid on the conclusion derived from these comparisons because of the small numbers of sires included and because the amount of inbreeding and kinship is on the whole

TABLE 16.

Ancestral Analysis of the Pedigrees of the Bulls which Sired Significantly Low Butter-Fat Testing Daughters

No.	Name of Sire	Registry No.	Z_1	Z_2	Z_3	ZT_3	K_2	K_3	K_4
449	Riverview Hengerveld	93371	0	0	0	0	0	0	0
448	Emblagaard Prince	80596	0	0	0	0	0	0	0
447	Missouri Chief Josephine Lad	70857	0	0	0	0	0	0	0
446	Madge Prince Hartog	56632	0	0	6.3	3.0	0	0	0
445	Sir Jolie Johanna	36664	0	0	18.8	8.8	0	0	0
444	Duke Ormsby DeKol Creamelle	63578	0	0	6.3	3.0	0	0	0
443	Tehee Lilith Pauline DeKol	36636	0	12.5	18.8	8.8	0	0	12.5
442	Segis Longfield Homestead	75627	0	0	0	0	0	0	0
441	Cedar Lawn Sir Johanna	104002	0	0	12.5	5.9	0	0	12.5
440	Spring Brook Hengerveld Parthenea	68946	0	0	0	0	0	0	0
439	Count Pietertje Hengerveld DeKol	41757	0	0	0	0	0	0	0
438	Lord Nudine DeKol	35639	0	0	6.3	3.0	0	0	0
428	Aaggie Cornucopia Johanna Lad Jr.	36974	0	12.5	12.5	10.0	0	25.0	25.0
425	Arcady Segis Hengerveld Wayne	75304	0	0	0	0	0	0	0
424	Butter Boy Sir Mechthilde	37302	0	0	0	0	0	0	0
420	Sir Mooie Oak DeKol	41220	0	0	12.5	5.9	0	0	12.5
418	Sir Beets Cornucopia Netherland	38460	0	12.5	12.5	10.0	0	25.0	25.0
403	Sir Concordia Korndyke	75012	0	0	6.3	3.0	0	0	12.5
391	Mutual Friend DeKol Albrice	38079	0	12.5	18.8	8.8	0	0	0
387	Sir Johanna Fayne	42147	0	0	12.5	5.9	0	0	12.5
378	Johanna Colantha Sarcastic Lad	38402	0	0	6.3	3.0	0	0	0
373	Paul Frenesta DeKol	41206	0	0	12.5	5.9	0	0	25.0
	Mean		0.0	2.27	6.95	3.86	0.0	2.27	6.25

low, with the differences small in comparison with the probable errors on page 138.

Table 16 gives the same inbreeding and relationship coefficients for those sires whose daughters are significantly low in their butter-fat test.

No sire of the 22 contained in table 16 shows any inbreeding up to and including the second generation. In the third generation 4 sires were inbred. In the fourth generation 14 were inbred. In percentage, zero per cent showed inbreeding in the second generation, 18.1 per cent showed inbreeding in the third generation and 63.6 per cent showed inbreeding in the fourth generation. The percentage of sires in this table which show inbreeding is approximately the same as that for the sires of table 13. Thus, sires of high butter-fat testing daughters are no more frequently inbred than the sires of low testing daughters.

No sire of the 22 contained in table 16 showed any relationship between the sire and dam in the second generation. Two sires or 9.1 per cent came from matings in which the sire and dam were related in the third generation. Eight sires 36.3 per cent were from matings with related sire and dam in the fourth generation. The number of sires of daughters low in butter-fat percentage which display kinship between their sire and dam is consequently somewhat less than the number of sires of daughters high in butter-fat percentage which display similar kinship between the sire and dam.

Turning now to the amount of inbreeding as shown in table 16 it is seen that there is no inbreeding in the second generation, 0 to 12.5 per cent in the third generation with an average of 2.27 per cent for all sires and 0 to 18.8 per cent in the fourth generation with an average of 6.95 per cent. No sire displays more than 10.0 per cent of the maximum possible inbreeding. The average for all sires is 3.86 per cent of the maximum inbreeding which could exist up to the fifth generation. These figures show that the actual amount of inbreeding is rather small. Compared with the inbreeding of those sires whose daughters were high in their butter-fat percentage, the sires are only about 3/5 as much inbred.

The amount of kinship between the parents of these different sires in table 16 is small. There is no kinship in the sec-

ond generation, 2.27 per cent in the third generation and 6.25 per cent in the fourth generation. No sire shows more than 25 per cent of the amount possible. These sires showed only 55 per cent of the amount of kinship between their parents as is shown by the sires whose daughters are high butter-fat testers.

The results of this study of the inbreeding and kinship as contained in the pedigrees of the sires whose daughters had a high butter-fat test and of the sires whose daughters had a low butter-fat test may be briefly summarized. The amount of the inbreeding is rather low for each group of sires. The sires of the high butter-fat percentage daughters begin to be inbred in earlier generations, namely, the second and third, than do the sires of the low butter-fat percentage daughters. The amount of inbreeding is somewhat greater in the sires whose daughters butter-fat percentage is high. The amount of relationship between the parents of these two groups of sires is on the whole low. The parents of the sires whose daughters are high butter-fat testers show nearly twice as much relationship as do the parents of the sires whose daughters are low in their butter-fat test. All differences are small, however, in fact are generally not significant.

If these results are compared with those obtained for the inbreeding and relationship of the random sample of the sires of the Holstein-Friesian breed as shown in table 10 it is found that the pedigree of random sample sires show more inbreeding than either the pedigrees of the sires of high testing daughters or of low testing daughters. The difference between the inbreeding of the sires of high testing daughters and the random sample sires is on the whole not significant.

Comparison of the relationship between the sire and dam of the high testing group with that of the random sample sires shows that there is a slightly greater relationship between the sire and dam for the random sample group for the second and third generation, but that the sires of the high testing group have a greater relationship in the fourth generation.

These facts argue for the belief that inbreeding as normally carried on within the Holstein-Friesian breed has no detrimental effect.

ANIMALS APPEARING IN THE PEDIGREES OF THE SIRES WHICH HAVE DAUGHTERS WITH A SIGNIFICANTLY HIGH BUTTER-FAT PERCENTAGE

As has been previously shown by the work of this laboratory the production of milk quantity has little correlation with milk quality. Such being the case it is desirable to examine the animals occurring in the pedigrees of those sires whose daughters have a high butter-fat percentage in their milk. The objects of such a pedigree analysis will be similar to those of the previous investigation of the animals occurring in the pedigrees of the group of sires whose daughters' milk yield was high and in the group of sires whose daughters' milk yield was low. The attempt will be made to determine what actual value the appearance of a certain famous animal within a pedigree of an unknown animal may have as a determiner of the unknown animal's worth when measured in terms of his daughters' butter-fat percentage.

Four generation pedigrees were formed for all animals appearing in the list of sires with daughters of significantly high butter-fat percentage. These pedigrees were then resolved into the animals which occur in each generation and with the number of times each appear in the given generation. The information was again classified to show which side of the pedigree each appearance was made. Table 17 contains this information for all sires whose daughters were significntly high in their butter-fat percentage as shown in table 14.

Many names already familiar to the reader from the previous study of the pedigrees in the groups of sires whose daughters were high or low in their milk yield, are recognized in table 17. DeKol 2d's Butter Boy 3d heads the list of sires as the sire of three of the sires whose daughters were high in their butter-fat test. Pietertje Hengerveld's Paul DeKol and Pontiac Korndyke both well known sires have two sons whose daughters were high in their butter-fat percentage. In the second generation Manor DeKol, Manor Josephine DeKol and DeKol 2d's Paul DeKol all appear 2 or more times on the sire's side of the pedigree. On the dam's side of the pedigree Hengerveld DeKol and DeKol 2d's Alban appear 3 times and 2 times, respectively. The females DeKol 2d, Belle Korndyke and Pietertje Henger-

TABLE 17.

Animals repeated in the pedigrees of sires whose daughters were significantly high or low milk producers or high or low in their butter-fat percentage. This table is for those sires whose daughters were significantly high in their butter-fat percentage.

Sire's Side of Pedigree Name	H.B. No.	No. of Appearances	Dam's Side of Pedigree	H.B. No.	No. of Appearances
FIRST GENERATION Males			FIRST GENERATION Females		
DeKol 2d's Butter Boy 3d	23260	3			
Pietj Heng's Paul DeKol	22128	2			
Pontiac Korndyke	25982	2			
Males appearing once for which only herd book number need be given 25368, 29642, 31212, 32429, 35977, 46767			Females appearing once for which only herd book number need be given. 16004, 35907, 40962, 46762, 49131, 51585, 55792, 75749, 78051		
SECOND GENERATION Males			SECOND GENERATION Males		
Manor DeKol	21266	3	Hengerveld DeKol	23102	3
Manor Josephine DeKol	22779	2	DeKol 2d's Alban	17064	2
DeKol 2d's Paul DeKol	20735	2			
Males appearing once for which only herd book number need be given 22999, 22991, 23102, 23300, 25368, 25795, 26648, 32429, 36168			Males appearing once for which only herd book number need be given. 6154, 18458, 21226, 23200, 23269, 23366, 23538, 23711, 26936, 28660, 31312		
Females			Females		
DeKol 2d	734	3			
Belle Korndyke	13913	2			
Pietertje Hengerveld	24137	2			
Females appearing once for which only herd book number need be given. 2099, 35439, 37957, 43105, 48426, 49520, 52256, 55792, 60968, 68828			Females appearing once for which only herd book number need be given. 1892 D.F.H.B., 2372 H.H.B., 7492, 12586, 16004, 34745, 43465, 48632, 53646, 55163 59192		
THIRD GENERATION Males			THIRD GENERATION Males		
Willem III	190 N.H.B.	3	DeKol 2d's Butter Boy	21366	4
DeKol 2d's Netherland	11584	3	DeKol 2d's Netherland	11584	3
Milla's Pietj Netherland	7825	2	Netherland Alban	4584 H.H.B.	2
Silvan Hartog	8161	2	Sir Piebe DeKol	26239	2
Paul DeKol	14634	2			
Tritomia's Neth. Carl	16406	2			
Empress Josephine 3d's Sir Mecht.	20255	2			
DeKol 2d's Butter Boy	21366	2			
Homestead Jr. DeKol	28409	2			
Males appearing once for which only herd book number need be given 1115 H.H.B., 19108, 19484, 19856, 20735, 21724, 21847, 22128, 22187, 22909, 22991, 23447, 23538, 23971, 26648, 26939, 28930			Males appearing once for which only herd book number need be given. 1060 H.H.B., 4152 H.H.B., 5739 H.H.B., 5975 H.H.B., 2865, 6154, 12121, 13853, 14634, 15243, 15927, 20124, 20735, 21226, 21478 22372, 22584, 23300, 23366, 23378, 23637, 23971 24762		

Females		
Netherland Hengerveld	13106	5
DeKol	6245 H.H.B.	3
DeKol 2d	734	3
Kate Korndyke	238 D.F.H.B.	2
Agnes DeKol's Ellen	30228	2
Grace Fayne 2d	44124	2
Females appearing once for which only herd book number need be given. 6001 H.H.B., 10167 H.H.B., 16004, 19528, 21127. 22916, 29065, 29237, 31477, 33788, 35909, 37957, 39480, 42190, 43105, 43433, 44124 45164, 48632, 49131, 55163		

Females		
Magadora	29237	3
DeKol 2d	734	2
Almeda Luecke 2d	49520	2
Females appearing once for which only herd book number need be given. 938 D.F.H.B., 2575, 7402, 13106, 24137, 25939, 27881, 28389, 35439, 36420, 36617, 37842, 42168, 42182, 42188, 42832		

FOURTH GENERATION Males		
Aaggie Leila's Prince	4419 H.H.B.	5
Netherland Alban Mechtbilde Sir Henry of Maplewood	4584 H.H.B. 6296	3 3
Paul Mutual DeKol	18726	3
DeKol 2d's Paul DeKol	20735	3
Paul Hartog	6 M.R.	2
Willem III	190 N.H.B.	2
Prince of Monroe	1630 H.H.B.	2
Netherland Carl	3279 H.H.B.	2
Duke Netherland	1271	2
DeKol 2d's Prince	2767	2
Uncle Hicks 6th	6154	2
Milla's Pietj Netherland	7825	2
Pietertje 2d's Koningen	10625	2
Paul DeKol	14634	2
Netherland DeKol's Perfection	17713	2
Sir Abbekerk	19056	2
Aaltje Salo 3d's Tritomia Neth.	19856	2
Paul DeKol Jr.	24762	2
Males appearing once for which only herd book number need be given 5148, 7490, 8132, 11584, 11731, 11822, 12121, 16406, 17064, 19108, 19484, 20854, 21366, 21478, 21724, 21847, 21979, 22372, 22394, 23378, 23711, 23969, 23971, 24762		

FOURTH GENERATION Males		
Milla's Pietj Netherland	7825	6
Sir Abbekerk	19056	4
Willem III	190 N.H.B.	3
Netherland Alban	4584 H.H.B.	3
Aaltje Salo 3d's Tritomia Neth.	19856	3
Netherland Prince	716 H.H.B.	2
Uncle Hicks	1060 H.H.B.	2
Inka Princess Pietj Neth.	13979	2
Paul DeKol	14634	2
Jeltje S. Neth. Pietertje	15927	2
Paul DeKol Clothilde	21198	2
Lord Neth. DeKol	22187	2
Males appearing once for which only herd book number need be given. 122 F.H.B., 418 D.F. H. B., 1630 H.H.B., 2150 H.H.B., 2654 H.H.B., 3279 H.H.B., 3280 H.H. B., 4152 H.H.B., 4419 H.H.B., 6245 H.H.B., 1271, 2767, 6292, 11584, 14881, 16406, 18924, 20735. 21226, 21400, 21506, 21970. 22128, 22394, 23226, 23971		

Females		
DeKol 2d	734	6
Madame Hengerveld	1333	5
Pauline Paul	2199 H.H.B.	3
3d Maartje Korndyke	17 M.R.	2
Lutske 2d	267 D.F.H.B.	2
Tritomma	4004 H.H.B.	2
DeKol	6245 H.H.B.	2
Milla	6408 H.H.B.	2
Empress Josephine 3d	1995	2
Agnes DeKol	29200	2
Susie DeKol	33688	2
Grace Fayne	37840	2
Homestead Heroine DeKol	46490	2

Females		
DeKol 2d	734	8
Netherland Hengerveld	13106	5
DeKol	6245 H.H.B.	2
Almeda Luecke	19528	2

Females appearing once for which only herd book number need be given. 31624 H.H.B., 8687 H.H.B., 733, 2575, 6324, 7402, 7403, 10933, 12586, 13106, 15681, 21127, 21223, 22916, 23039, 24137, 29065, 30836, 31477, 33403, 33788, 35028, 36617, 39480, 42167, 42182, 42188, 42190, 43433	Females appearing once for which only herd book number need be given. 184 N.H.B., 1093 D.F.H.B., 2199 H.H.B., 2654 H.H.B., 3772 H.H.B., 3990 H.H.B., 5739 H.H.B., 5765 H.H.B., 5868 H.H.B., 5975 H.H.B., 6716 H.H.B., 8466 H.H.B., 10139 H.H.B., 1333 4288, 9343, 9702. 12586, 16002, 16004, 18314. 20179. 23039, 24636, 36722. 29065, 32259, 32290, 33688 35909, 36420, 36478, 42167

veld appear more than once on the sire's side of the pedigree. In the third generation, those bulls appearing most frequently are Willem III and DeKol 2d's Netherland on the sire's side, DeKol's 2d's Butter Boy and DeKol 2d's Netherland on the dam's side. The leaders for the females in this generation are Netherland Hengerveld, DeKol and DeKol 2d for the sire's side and Magadora for the dam's side of the pedigree. The cow, DeKol 2d leads both sexes on the sire's side and, on the dam's side, in the number of her appearances in the fourth generation.

The complete summary of all appearances for each animal in the four generations is given below. The order of arrangement of the names is in accord with the number of times which the animal appeared in the pedigrees of this group. The numbers in the parentheses following the name give first the number of appearances on the sire's side of the pedigree and second the number of appearances on the dam's side of the pedigree. All bulls or cows occurring more than 3 times are given. The bulls are: Milla's Pietertje Netherland (4-6), DeKol 2d's Netherland (4-4), Willem III (5-3), Netherland Alban (3-5), DeKol 2d's Paul DeKol (6-2), Paul DeKol (4-3), DeKol 2d's Butter Boy (3-4), Sir Abbekerk (2-4), Manor DeKol (3-3), Aaggie Leila's Prince (5-1), Aaltje Salo 3d's Tritomia Netherland (3-3), Hengerveld DeKol (1-3), DeKol 2d's Butter Boy 3d (3-1), Sarcastic Lad (2-2), Pietertje Hengerveld's Paul DeKol (3-1), Uncle Hicks 6th (2-2), Tritomia's Netherland Carl (3-1), Mechthilde's Sir Henry of Maplewood (3-1), DeKol 2d's Prince (2-1), DeKol 2d's Alban (1-2), Duke Netherland (2-1), Lord Netherland DeKol (1-2), Uncle Hicks (0-3), Paul Mutual DeKol (3-0), Prince of Monroe (2-1), Netherland Carl

(2-1), Paul DeKol Jr. (2-1), Jeltje S. Netherland's Pietertje (0-3).

The females which appear 3 or more times within this group are: DeKol 2d (12-10), Netherland Hengerveld (6-6), DeKol (5-3), Madame Hengerveld (5-1), Pietertje Hengerveld (3-1), Pauline Paul (3-1), Duchess Ormsby (1-3), Magadora (1-3), Piebe 2d (1-2), Piebe Queen (2-1), Susie DeKol (2-1), Almeda Luecke (1-2), Almeda Luecke 2d (1-2), Canary's Mercedes (1-2).

Many names appearing in this list will be recognized as belonging to prominent animals within the breed. As in the previous case the chief interest of these repeated animals, which occur in the pedigrees of the sires with high butter-fat testing daughters, lies in its comparative value. The breeder wants to know if these animals also occur in the pedigrees of the sires who have low testing daughters and if the frequency of occurrence is the same. The succeeding section gives the lists of animals and makes the desired comparison.

ANIMALS APPEARING IN THE PEDIGREES OF THE SIRES WHICH HAVE DAUGHTERS WITH A SIGNIFCANTLY LOW BUTTER-FAT PERCENTAGE

The animals appearing in the pedigrees of the sires whose daughters are low in their butter-fat percentage are given in table 18. The entries of the animals are so arranged as to show the generation in which the bull or cow appear, the side of the pedigree in which the appearance took place and the number of appearances.

From table 18 the bulls which appear 3 or more times in the pedigrees of this group may be extracted. These bulls are: *Paul DeKol* (9-8), *DeKol 2d's Paul DeKol* (4-6), *Sarcastic Lad* (7-1), *Maurice Bonheur* (7-1), *DeKol 2d's Butter Boy* (4-3), *Aaggie Cornelia 5th's Clothilde Imperial* (3-4), *Inka Princess Pietertje Netherland* (1-5), Paul Beets DeKol (2-4), *Milla's Pietertje Netherland* (4-1), *Willem III* (5-0), *DeKol 2d's Netherland* (2-2), *Aaltje Salo 3d's Tritomia Netherland* (2-2), *Pietj. Hengerveld's Paul DeKol* (2-2), *Duke Netherland* (4-0), *Paul Mutual DeKol* (1-3), *Paul DeKol Jr.* (2-2), *Johanna Rue 2d's Paul DeKol* (2-2), Johanna Aaggie's Sarcastic Lad (3-1),

Sarcastic (3-1), Maurice Clothilde (3-1), *Sir Abbekerk* (2-1), *Manor DeKol* (1-2), *DeKol 2d's Prince* (3-0), *Billy McKinley* (2-1), *Homestead Jr. DeKol* (1-2), *King Segis* (2-1), *Mercedes Julip's Pietertje's* Paul (2-1), *Mutual Friend 3d's Paul* (3-0), *Sir DeKol Mechthilde* (3-0), Pietertje Hengerveld's Count DeKol (2-1), Artis Adrantum's Clothilde (0-3), DeKol 2d's Mutual Paul (3-0), Mooie Hartog 2d (0-3), Pietertje Alban DeKol (2-1).

TABLE 18.

Animals repeated in the pedigrees of sires whose daughters were significantly high or low milk producers or high or low in their butter-fat percentage. This table is for those sires whose daughters were significantly low in their butter-fat percentage.

Sire's Side of Pedigree Name	H.B. No.	No. of Appearances	Dam's Side of Pedigree Name	H.B. No.	No. of Appearances
FIRST GENERATION Males			FIRST GENERATION Females		
Aaggie Cornucopia Johanna Lad	32554	2			
Males appearing once for which only herd book number need be given. 23224, 23971, 25700, 26533, 26936, 30412, 31943, 32846, 35237			Females appearing once for which only herd book number need be given. 35164, 66793		
SECOND GENERATION Males			SECOND GENERATION Males		
Johanna Aaggie's Sarcastic Lad	26935	3	Paul Beets DeKol	22235	2
Sareastic Lad	23971	2	Homestead Jr. DeKol	28400	2
DeKol 2d's Mutual Paul	25700	2			
King Segis	36168	2			
Males appearing once for which only herd book number need be given. 21306, 22394, 23102, 23200, 23260, 25467, 25865, 28400			Males appearing once for which only herd book number need be given. 18508, 20578, 21329, 21724, 23022, 23224, 23447, 23971, 36168		
Females			Females		
DeKol 2d	734	2	Lily Netherland	39453	2
Aaggie Cornucopia Pauline	48426	2			
Females appearing once for which only herd book number need be given. 23039, 24137, 26731, 37486, 40962, 42168, 43434, 44124, 50734			Females appearing once for which only herd book number need be given. 10725, 27463, 30836, 35164, 41332, 51297		

THIRD GENERATION Males			THIRD GENERATION Males		
Sarcastic Lad	23971	4	Paul Mutual DeKol	18726	3
Paul DeKol	14634	3	Aaggie Grace's Pietj's Clothilde	20697	2
DeKol 2d's Paul DeKol	20735	3	DeKol 2d's Paul DeKol	20735	2
Maurice Bonheur	22394	2	Paul Beets DeKol	22235	2
Mutual Friend 3d's Paul	23200	2	Paul DeKol Jr.	24762	2
Paul DeKol Jr.	24762	2			
Clothilde Goudgeld Hugo	27525	2			
Mercedes Julip Pietj's Paul	29830	2			
Males appearing once for which only herd book number need be given. 190 N.H.B., 2865, 4729, 7825, 13979, 17638, 19056, 19308, 19484, 19856, 20676, 21226, 21366, 21506, 22128, 22584, 23224, 23227, 23446, 26025, 26221			Males appearing once for which only herd book number need be given. 407 D.F.H.B., 588 H.H.B., 1002 H.H.B., 3914, 11822, 16179, 16469, 17713, 18025, 18508, 19653, 19856, 20657, 21226, 21366, 23394, 22991, 23227, 26221, 26533, 29830, 30412		
Females			Females		
Johanna Aaggie	36477	3	Jessie Beets	8123	2
DeKol 2d	734	3	Aaggie Lily 3d's Netherland	34799	2
Aaggie Cornucopia	21127	2	Homestead Heroine DeKol	46490	2
Belle Sarcastic	23039	2			
Mutual Friend 3d	28389	2			
A & G Inka McKinley	55163	2			
Females appearing once for which only herd book number need be given. 6245 H.H.B., 8494 H.H.B., 4553, 11227, 13106, 16004, 18314, 29237, 35907, 36478, 37840, 39530, 42168, 43465, 44887, 46490, 48577, 53334			Females appearing once for which only herd book number need be given. 1093 D.F.H.B., 1516 D.F.H.B., 9343, 10723, 10725, 23039, 24137, 26731, 30836, 32290, 33788, 34628 35028, 39947, 55163, 64169		

FOURTH GENERATION Males			FOURTH GENERATION Males		
Paul DeKol	14634	7	Paul DeKol	14634	8
Willem III	190 N.H.B.	4	Inka Princess Pietj. Neth.	13979	5
Duke Netherland	1271	4	DeKol 2d's Paul DeKol	20735	4
Maurice Bonheur	22394	4	Aaggie Cornelia 5th's Clothilde Imperial	11822	3
DeKol 2d's Prince	2767	3	Artis Adiantum's Clothilde	15202	3
Milla's Pietertje Netherland	7825	3	Billy Boelyn	189 H.H.B.	2
Aaggie Cornelia 5th's Clothilde Imperial	11822	3	Conqueror	388 H.H.B.	2
Aaggie Leila's Prince	4419 H.H.B.	2	Mooie Hartog 2d	407 D.F.H.B.	2
Sarcastic	4729	2	Mooie Hartog 4th	418 D.F.H.B.	2
Aaggie 3d's Prince	5148	2	Billy Bawn	3087 H.H.B.	2
DeKol 2d's Netherland	11584	2	Bassano	3917 H.H.B.	2
Maurice Clothilde	17638	2	DeKol 2d's Netherland	11584	2
DeKol 2d's Butter Boy	21366	2	DeKol 2d's Butter Boy	21366	2
Sir DeKol Mechthilde	21506	2	Pietj Heng.'s Paul DeKol	22128	2
Johanna Rue 2d's Paul DeKol	21724	2			
Paul Beets DeKol	22235	2			
Billy McKinley	23378	2			
Clothilde Goudgeld Lad	25080	2			
Prince Kuperus Pietj Hartog	25871	2			
Males appearing once for which only herd book number need be given.			Males appearing once for which only herd book number need be given.		

361 D.F.H.B., 628 D.F. H.B., 716 H.H.B., 1164 H.H.B., 2150 H.H.B., 1969, 6154, 8781, 10156, 12121, 12525, 16406, 16469, 17064, 18025, 18726, 18924, 19056, 19667, 19668, 19856, 20124, 20735, 21676, 22128, 22991, 23109, 23227, 23446, 23469, 25865			588 H.H.B., 2767 H.H. B., 3259, H.H.B., 1281, 3914, 4729, 6296, 7825, 8781, 9130, 10625, 15437, 16406, 17638, 19056, 19856, 20255, 21226, 21676, 21724 23260, 23378, 25368, 25755, 26935		
Females			Females		
DeKol	6245 H.H.B.	4	DeKol 2d	734	4
DeKol 2d	734	4	Johanna	344 H.H.B.	3
Belle Sarcastic	23039	4	Mutual Friend 2d	10513	3
Pauline Paul	2199 H.H.B.	3	Aaggie Lily 3d	1128	2
Johanna 4th	2129	3	Jessie Beets	8123	2
Cornucopia	8687 H.H.B.	2	Netherland Hengerveld	13106	2
Pleasant Valley Maid	9431 H.H.B.	2	Aaggie Grace's Pietj	26732	2
Mutual Friend	10139 H.H.B.	2	Sadie Vale Concordia	32259	2
Belvisia 2d	4553	2	Heroine DeKol	41387	2
Rosa Bonheur 5th	11227	2			
Netherland Hengerveld	13106	2			
Pietertje Hengerveld	24137	2			
Mutual Friend 3d	28389	2			
Sadie Vale Concordia	32259	2			
Segis Inka	36617	2			
Mercedes Julip's Pietertje	39480	2			
Carlotta Clothilde	40675	2			
Females appearing once for which only herd book number need be given. 890 H.H.B., 893 D.F.H.B., 1675 D.F. H.B., 2372 H.H.B., 2618 H.H.B., 3990 H.H.B., 6408 H.H.B., 10013 H. H.B., 1333, 2575, 6324, 7402, 7403, 7970, 12702, 20229, 21223, 23833, 24636, 25939, 39759, 33788, 35028 35547, 36478, 40082, 41387, 41934			Females appearing once for which only herd book number need be given. 539 H.H.B., 542 H.H.B., 1516 D.F.H.B. 2767 H.H.B., 6651 H.H. B., 6714 H.H.B., 6716 H.H.B., 6733 H.H.B., 8494 H.H.B., 4553, 7403 9343, 10723, 11227, 16304 19524, 21127, 21223, 22916 26731, 29312, 30759, 32285 35547, 36617, 39489, 43434 53334		

The cows who appear 3 or more times within the pedigrees are: *DeKol 2d* (9-4), *Belle Sarcastic* (7-1), *Netherland Hengerveld* (3-2), *DeKol* (5-0), *Pietertje Hengerveld* (3-1), *Mutual Friend 3d* (4-0), *Sadie Vale Concordia* (2-2), Belvisia 2d (3-1), Rosa Bonheur 5th (3-1), Jessie Beets (0-4), *Pauline Paul* (3-0), *A & G Inka McKinley* (2-1), *Segis Inka* (2-1), *Mercedes Julip's Pietertje* (2-1), Johanna Aaggie (3-0), Johanna 4th (3-0), Johanna (0-3), Mutual Friend 2d (0-3), *Aaggie Cornucopia* (2-1), *Homestead Heroine DeKol* (1-2), Heroine DeKol (1-2), Aaggie Grace 2d's Pietertje (1-2).

It will be noted that certain of the animals named in the preceding paragraph are in *italics*. These animals are found not only within the pedigrees of the sires whose daughters are low in their butter-fat percentage but are also found in the list of sires which have daughters significantly high in their butter-fat percentage. The animals which are in italics are clearly in

the majority. Of the bulls, 25 are in italics to 9 which are not; of the cows, 13 are in italics to 9 which are not.

If the other comparison is made of the bulls which occur 3 or more times in the pedigrees of the sires, which have daughters significantly high in their butter-fat percentage (as previously given) with those which occur in the pedigrees of those bulls whose daughters are significantly low in their butter-fat percentage, we find that all but 6 of these bulls and all but 5 of these cows appear in the pedigrees of the sires of low testing daughters.

Such being the case how can a breeder tell what a young bull's daughters will do as milk producers? Obviously, with the repetition of the prominent sires, indiscriminately, in the high butter-fat percentage group and in the low butter-fat percentage group it would appear as if it were impossible to determine *a priori* from the pedigree what such a young bull's daughters would do as milk producers. There is, however, one other point to be investigated before this conclusion can be drawn. It may be that within these two groups the same sires are present but it may equally be true that the frequency with which these sires appear may be very different, that is, a given bull may appear 10 times in the high butter-fat test group and only once in the low butter-fat test group. Such being the case it might be justifiable to suppose that this bull's presence would generally mean a sire of high butter-fat testers.

The investigation of this problem is best accomplished by the correlation method. All possible correlations for the different divisions of the data have been made either for comparison or for its direct analytical value. The terms used to express the divisions are:

Milk refers to the two groups of pedigrees of the sires which have daughters high or low in their milk production.

B.F.% refers to the two groups of pedigrees of the sires which have daughters high or low in their butter-fat percentage.

+ (plus) refers to those groups of pedigrees of the sires which have daughters high in either their milk yield or butter-fat percentage.

— (minus) refers to those groups of pedigrees of the sires which have daughters low in either their milk yield or butter-fat percentage.

Sire's refers to the side of the pedigrees on which the animals appear.

Dam's indicates the side of the pedigree in which the animal appeared.

Males indicate that the data dealt with refer only to the bulls which appear in the different pedigree groups.

TABLE 19.

Correlation coefficients for the frequency of appearance of the bulls and cows within the pedigrees of the sires of the four following groups (1) Sires of daughters with significantly high milk yield, table 11; (2) Sires of daughters with significantly low milk yield, table 12; (3) Sires of daughters with significantly high butter-fat percentage, table 16; (4) Sires of daughters with significantly low butter-fat percentage, table 18.

Characters Correlated	Correlation Coefficients	
	Males	Females
Milk+Sire's and Milk—Sire's	+0.569±.033	+0.534±.034
Milk+Sire's and B.F. %+Sire's	.545±.034	.516±.035
Milk+Sire's and B.F. %—Sire's	.580±.032	.587±.031
Milk+Sire's and Milk+Dam's	.484±.037	.336±.042
Milk+Sire's and Milk—Dam's	.090±.048	.229±.045
Milk+Sire's and B.F. %+Dam's	.295±.044	.270±.044
Milk+Sire's and B.F. %—Dam's	.413±.040	.175±.046
Milk—Sire's and B.F. %+Sire's	.625±.030	.732±.022
Milk—Sire's and B.F. %—Sire's	.660±.027	.654±.027
Milk—Sire's and Milk+Dam's	.635±.029	.657±.027
Milk—Sire's and Milk—Dam's	.324±.043	.432±.038
Milk—Sire's and B.F %+Dam's	.526±.035	.669±.026
Milk—Sire's and B.F. %—Dam's	.426±.040	.112±.047
B.F. %+Sire's and B.F. %—Sire's	.402±.041	.510±.035
B.F. %+Sire's and Milk+Dam's	.454±.039	.543±.033
B.F. %+Sire's and Milk—Dam's	.272±.045	.383±.040
B.F. %+Sire's and B.F. %+Dam's	.515±.036	.694±.030
B.F. %+Sire's and B.F. %—Dam's	.327±.043	.171±.046
B.F. %—Sire's and Milk+Dam's	.288±.045	.387±.040
B.F. %—Sire's and Milk—Dam's	.492±.037	.613±.029
B.F. %—Sire's and B.F. %+Dam's	.627±.029	.459±.037
B.F. %—Sire's and B.F. %—Dam's	.576±.032	.546±.033
Milk+Dam's and Milk—Dam's	.157±.047	.190±.046
Milk+Dam's and B.F. %+Dam's	.187±.047	.163±.046
Milk+Dam's and B.F. %—Dam's	.610±.030	.538±.034
Milk—Dam's and B.F. %+Dam's	.178±.047	.382±.040
Milk—Dam's and B.F. %—Dam's	.366±.042	.499±.035
B.F. %+Dam's and B.F. %—Dam's	.431±.040	.216±.045
Correlations for each pedigree group irrespective of the side on which the appearance may occur		
Milk+ and Milk—	.595±.033	.687±.027
Milk+ and B.F. %+	.574±.033	.659±.027
Milk+ and B.F. %—	.735±.025	.645±.027
Milk—and B.F. %+	.667±.027	.777±.025
Milk— and B.F. %—	.496±.034	.535±.033
B.F. %+ and B.F. %—	.390±.040	.450±.040

Females indicate that the data dealt with refer only to the cows which appear in the different groups.

The correlation coefficients derived from these data are shown in table 19.

All possible correlation for the number of entries of the different sires within the four pedigree groups (high milk producing and low milk producing, high butter-fat percentage and low butter-fat percentage) together with the side of the pedigree on which the entry took place are included in this table. Before considering the results themselves it may be well to consider what the expectation would be if the animals appearing within the pedigrees of each group were differentiated in accordance with the postulate "like begets like." That is, an animal within the pedigree of the high group would be there because his hereditary factors for milk production or butter-fat percentage are high. Under this postulate it would be expected that animals which were within the pedigrees of the high group would not appear in the pedigrees of the low group. With breeding operations as they are carried on such a condition of affairs is unlikely. What would rather be expected is that some of the animals would probably appear in both high and the low group. Such being the case, the expectation would be that a negative correlation would exist between the number of appearances of the animals in the high milk producing group and the number of appearances in the low milk producing group. Explained somewhat more fully this would mean that the animals appearing most frequently in the high group would not be expected to appear in relatively as great frequency in the low milk producing group as those animals which appear less frequently in the high milking group would appear in the low milking group. The reason for this is that those animals which appear most frequently in one group would be expected to carry the most factors of this group, whereas those appearing less frequently would be expected to occur there by chance.

Entirely similar reasoning will lead to the expectation of a negative correlation for the relative appearances of the animals in the pedigrees of the high butter-fat percentage group when correlated with the low butter-fat percentage group.

As previously determined the correlation between quantity of the milk yield and quality of the milk is so close to zero as

to be scarcely significant. Such being the case the appearance of the animals within the pedigrees of the cross groups, vs high milk yield and high butter-fat percentage, would be expected to be at random or the correlation would be expected to be zero.

The other cross correlations are those between the animals occurring in the sire's pedigree and those occurring in the dam's pedigree of the same group. Here the expectation would be that the animals appearing would be of like inheritance. Such being the case they would be expected to appear in about equal proportions in each group. Under these circumstances the correlation would be positive and of good size.

With these considerations before us the correlations of table 19 as actually obtained for these groups may receive our attention. The six correlations for each pedigree group, irrespective of the side of the pedigree on which the appearance may occur is given at the bottom of the table. These correlations are all plus and of good size. Each correlation is significant. The correlation between the animals appearing in the pedigree of the high milk yielding group with those appearing in the pedigree of the low milk yielding group is +0.595, whereas, on our previous reasoning it should have been a small quantity, probably minus, if the saying quoted holds true in its entirety. The next four correlation coefficients are for the cross correlations. These correlation coefficients should be nearly zero by our previous reasoning, whereas they average .618 for the males. This lack of agreement between the expectation and actuality show that in all probability the hypothesis on which we are working is not applicable to these results. That is, because a certain bull appears in the pedigree of a high class sire it is unfortunately no guarantee that that bull is, himself, good in his hereditary factors. This statement applies more particularly to those animals appearing in the third and fourth generations of the pedigree, for as a study of the complete tables will reveal it is these animals which are most often repeated due, of course, to their greater number within the pedigree.

It will be noted that the correlation between the animals appearing in the pedigrees of those sires whose daughters were high in butter-fat percentage and the pedigrees of those sires whose daughters were low in butter-fat percentage is a signifi-

cant plus quantity but is, also, significantly below the other correlations.

If another factor which undoubtedly influences the number of appearances (of a given bull), that is, the popularity of an animal due to advertising, and not necessarily due to real worth is drawn into the discussion as a co-hypothesis to the previous one, the expectation would be quite different from that previously given for the single hypothesis "like begets like." The cross correlation for the four variables, high milk yield with high butter-fat percentage, high milk yield with low butter-fat percentage, low milk yield with high butter-fat percentage, and low milk yield with low butter-fat percentage, would largely represent the correlation which would exist due to the popularity of the animals alone. The difference of the direct correlation coefficients for high milk yield and low milk yield, and high butter-fat percentage and low butter-fat percentage would represent to some degree the true worth of the animal. The correlation coefficient for high milk yield and low milk yield is 0.595. The average cross correlation coefficient is .618. Clearly these correlation coefficients do not differ significantly. Such being the case the following conclusions appear justified.

(a) The magnitude of the average cross correlation makes it clear that popularity of the bull or some similar cause rather than true worth plays a large part in causing the appearance of an animal within a pedigree, at least, in the third and fourth generations.

(b) The close similarity of the correlation between the bulls appearing in the high milking group and the bulls appearing in the low milking group with the average cross correlation shows that the appearance of a bull in the pedigree of the high group is no necessary guide to that animal's worth.

(c) The fact that a bull whose progeny performance is unknown, has a well known bull or bulls in his pedigree is unfortunately no indication of that unknown bull's worth.

The correlation coefficient between the animals appearing in the pedigrees of the high butter-fat testing group and the animals appearing in the pedigrees of the low butter-fat testing group is .390. This correlation coefficient is lower than the average of the cross correlations, .618, by an amount which is, probably, significant. Such being the case it would seem that

the appearance in the pedigree of an unknown sire, of a bull, which is known to appear frequently in the pedigree of sires of high butter-fat percentage daughters is an indication of the worth of the unknown bull as a sire of high butter-fat test.

This part of the discussion has been devoted entirely to the bulls. Examination of the correlations for the females indicates that the correlation coefficients for the different groups are in practical agreement with those for the bulls. Such being the case the conclusion drawn from the study of the bulls are of equal force for the females.

The major portion of table 17 is devoted to the correlations for the animals as they appear on the sire's or dam's side of the table. These correlations point to certain facts in regard to pedigree make up. If the average correlation is found for the bulls or cows on the sire's side of the pedigree, without regard to the group to which they belong, the correlations are found to be significantly higher than the average correlation for the bulls or cows on the dam's side of the pedigree when correlated between groups. Such a condition of affairs argues for greater attention being paid to the selection of the sire's pedigree of a bull to be used as a sire than is paid to the selection of the dam's pedigree.

The average correlation for the bulls or cows which appear on the sire's side of the pedigree correlated with those appearing on the dam's side of the same pedigree, is smaller than is the correlation of the bulls which appear on the sire's side of the pedigree correlated between groups. Such a condition of affairs would indicate that there is a greater kinship between the animals in the sire's side of the pedigree for the different groups than exists between the animals on the sire's and dam's side of the pedigrees for the same groups.

ANIMALS FOUND IN THE PEDIGREES OF RANDOM SAMPLES OF HOLSTEIN-FRIESIAN SIRES WITHOUT ADVANCED REGISTRY DAUGHTERS OR SONS IN RELATION TO THE ANIMALS FOUND IN THE PEDIGREES OF HOLSTEIN-FRIESIAN SIRES WITH HIGH OR LOW MILK YIELD OR BUTTER-FAT PERCENTAGE DAUGHTERS.

One more phase of this subject should be considered before passing on to the next subject. The previous studies on the pedigrees of these Holstein-Friesian sires have all dealt with animals with advanced registry records, divided, it is true, into the very high and the very low groups, but still, nevertheless, animals which were advanced registry animals. Now it may be argued on what might seem to be perfectly justified *a priori* reasoning that these advanced registry animals studied were in a class by themselves. For while no difference in pedigree might be found for the high and low groups still an immense difference in pedigree would be found between them and the rest of the sires within the breed. To test this hypothesis the authors have studied the four generation pedigrees of the 33 sires selected at random given in table 9. All animals appearing more than once in any of the pedigree groups studied, high milk yield, low milk yield, high butter-fat percentage, low butter-fat percentage and random sample which appeared in the random sample pedigrees are listed below with the side of the pedigree on which the appearance occurred.

TABLE 20.

Animals repeated in the pedigrees of advanced registry sires or random sample sires. This table is for those sires which are selected at random and which have no advanced registry daughters.

Sire's Side of Pedigree Name	H.B. No.	No. of Appearances	Dam's Side of Pedigree Name	H.B. No.	No. of Appearances
FIRST GENERATION Males appearing once for which only herd book number need be given. 20831, 29303, 30190, 44968			FIRST GENERATION		

SECOND GENERATION Males			SECOND GENERATION Males		
Pontiac Korndyke	25982	2			
Males appearing once for which only herd book number need be given. 8519, 12863, 16469, 20928, 22618, 22638, 23260, 23450, 24762, 25368, 25467, 30190, 32554, 23227, 29521			Males appearing once for which only herd book number need be given. 19108, 20735, 20831, 22618, 29303, 38828, 44968		
Females			Females		
Females appearing once for which only herd book number need be given. 7744, 16004, 49460, 49905			Females appearing once for which only herd book number need be given. 19316, 44311		
THIRD GENERATION Males			THIRD GENERATION Males		
Echo's Prince of Wayne	31	2	Paul DeKol	14634	2
Mecht Sir Henry of Maplewood	6296	2	DeKol 2d's Butter Boy	21366	2
Duke Clothilde 7th	11412	2	Prince Pietertje DeKol	22238	2
Paul DeKol	14634	2	Pontiac Butter Boy	23154	2
Johanna Rue 2d's Paul DeKol	21724	2	DeKol Copia Pledge	24861	2
Manor Josephine DeKol	22779	2	Emperor Vevie DeKol	32306	2
Hengerveld DeKol	23102	2			
Mutual Friend 3d's Paul	23200	2			
Colantha Gerben DeKol	31186	2			
Sir Mechthilde Jewel	32732	2			
Males appearing once for which only herd book number need be given. 3280 H.H.B., 6154, 10497, 14446, 15202, 17713, 18379, 20735, 20843, 21226, 21366, 22128, 22235, 22238, 22991, 23224, 23446, 25368, 25700, 26345, 26935, 31398, 32306			Males appearing once for which only herd book number need be given. 2933 H.H.B., 7825, 10497, 10625, 11412, 16469, 19668, 19930, 20735, 20843, 21704, 22128, 22638, 23022, 23260, 24762, 26939, 28779, 30907, 32554, 38828		
THIRD GENERATION Females			THIRD GENERATION Females		
Betz 2d	1770 H.H.B.	2			
Belle Korndyke	13913	2			
Females appearing once for which only herd book number need be given. 1119 H.H.B., 6714 H.H.B., 6716 H.H.B., 734, 7402, 7744, 10470, 16304, 24137, 30759, 32006, 32259, 34745, 37060, 37957, 42168, 44223, 48426, 50663, 60964			Females appearing once for which only herd book number need be given. 734, 6324, 7744, 10470, 20200, 20238, 22916, 23963, 44311, 49460, 49905, 61262		
FOURTH GENERATION Males			FOURTH GENERATION Males		
DeKol 2d's Butter Boy	21366	5	DeKol 2d's Prince	2767	3
Paul DeKol	14634	4	Duke Netherland	1271	2
DeKol 2d's Paul DeKol	20735	4	Mella's Pietertje Neth.	7825	2
DeKol 2d's Netherland	11584	3	Paul DeKol	14634	2
Paul Mutual DeKol	18726	3	Netherland Duke of Wayne	15569	2
Count Paul DeKol	19108	3	Neth. DeKol's Perfection	17713	2
DeKol Bettina	23964	3	Sir Abbekerk	19056	2
Clothilde 4th's Imperial	1281	3	DeKol 2d's Paul DeKol	20735	2
Sir Henry of Maplewood	2933 H.H.B.	3	DeKol 2d's Butter Boy	21366	2
Prince of Wayne 2d	736 H.H.B.	2	Prince Pietertje DeKol	22238	2
Echo's Prince of Wayne	31	2	Mutual Friend 3d's Paul	23200	2

Duke Clothilde	2270	2	Vevie Night DeKol		
DeKol 2d's Prince	2767	2			
Silvan Hartog	8161	2			
Netherland Van Beers	16179	2		23637	2
Aaltje Salo 3d's Tritomia Neth	19856	2			
Empress Josephine 3d's Sir Mecht	20255	2			
Sir Pietertje Josephine Mechthilde	21412	2			
Sir DeKol Mechthilde	21506	2			
Virgo Beauty Duke	24528	2			
Colantha 4th's Lad	26940	2			
Males appearing once for which only herd book number need be given. 185 N.H.B., 190 N.H.B., 608 H.H.B., 1060 H.H.B., 4152 H.H.B., 4419 H.H.B., 4584 H.H.B., 1271, 6154, 7825, 10497, 10625, 11412, 11984, 14222, 15243, 19056, 19484, 20697, 22991, 23200, 23260, 23637, 23969, 23971, 25709			Males appearing once for which only herd book number need be given. 190 N.H.B., 608 H.H.B., 2933 H.H.B., 3279 H.H.B., 31, 1281, 2270, 2865, 6296, 8519, 8781, 11731, 11984, 12863, 14446, 17064 18379, 19653, 19930, 20255 20928, 21226, 21704, 22128 22235, 23260, 23300, 23450 23964, 23971, 25865, 26935 26939, 27945, 28779, 30907. 31398		
Females			Females		
Pauline Paul	2199 H.H.B.	3	DeKol 2d	734	5
DeKol 2d	734	3	Pauline Paul	2199 H.H.B.	2
Johanna Rue 2d	33788	3	Hiordi's Iceadorah 2d	23963	2
Pietertje Hengerveld	24137	2	Copia 2d's Pledge	27068	2
Echo	121 H.H.B.	2	Rag Apple Clothilde Artis	34741	2
Kate Korndyke	238 D.F.H.B.	2	Empress Josephine 3d's Gerben A.	39499	2
Lady Artis	4525 H.H.B.	2			
Mutual Friend 2d	28389	2			
Magadora	29237	2			
Myrtle Gerben DeKol	50608	2			
Females appearing once for which only herd book number need be given. 1119 H.H.B., 5739 H.H.B., 5975 H.H.B., 6245 H.H.B., 6714 H.H.B., 9431 H.H.B., 1452. 7402. 7744, 8123, 13106, 18449, 19316, 19848, 21127, 22916, 23963, 27881, 29065, 30228, 31477, 36477. 36478, 37957, 39499, 46762, 60964			Females appearing once for which only herd book number need be given. 1119 H.H.B., 4525 H.H.B., 6245 H.H.B., 6408 H.H.B., 6714 H.H.B., 6716 H.H.B., 733. 1452, 19848, 20238, 21127. 24137, 29312, 32006, 32259 33688, 36477, 37060, 42167. 44223, 48426, 61262		

A complete summary of all appearances for each animal in the four generations is given below. The order of the arrangement of the names is in accord with the number of times which the animal appears in the pedigrees of this group. The number in the parenthesis following the name gives first, the number of appearances on the sire's side of the pedigree and second, the number of appearances on the dam's side of the pedigree. The bulls appearing more than 3 times are *DeKol 2d's Butter Boy* (6-4), *Paul DeKol* (6-4), *DeKol 2d's Paul DeKol* (5-4), *Mutual Friend 3d's Paul* (3-2), *DeKol 2d's Prince* (2-3), Sir Henry of Maplewood (3-2), Prince Pietertje DeKol (1-4), Echo's Prince

of Wayne (4-1), *Milla's Pietertje Netherland* (1-3), *DeKol 2d's Butter Boy 3d* (2-2), *Count Paul DeKol* (3-1), *DeKol Bettina* (3-1), Duke Clothilde 7th (3-1), *Clothilde 4th's Imperial* (3-1), *DeKol 2d's Netherland* (3-0), *Paul Mutual DeKol* (3-0), *Pietertje Hengerveld's Paul DeKol* (1-2), *Sir Abbekerk* (1-2), *Vevie Night DeKol* (1-2), Glenoe Olaf (2-1), Royal Maid (2-1), Emperor Vevie DeKol (1-2), *Mechthilde's Sir Henry of Maplewood* (2-1), *Empress Josephine 3d's Sir Mechthilde* (2-1), *Netherland DeKol's Perfection* (1-2).

The cows appearing more than three times in this group of pedigrees are, *DeKol 2d* (4-6), *Pauline Paul* (3-2), Jewel Echo (3-1), Netherland Pietertje Princess (1-3), *Pietertje Hengerveld* (3-1), Rheah (2-1), Lady Artis (2-1), Empress Josephine 3d's Gerben A. (1-2), *Colantha* (2-1), *Johanna Rue 2d* (3-0).

The names of the bulls or cows appearing in italics in this list, also appear in the pedigrees of the advanced registry animals studied. As may be seen from table 21 the animals appearing in the pedigrees of the random sample sires appear in very nearly the same frequency in the pedigrees of the advanced registry group. The symbols used to designate the characters correlated are the same as those used in table 19.

If these correlations for the animals appearing in random sample pedigrees correlated with those of the other groups are examined together with the correlations for these other groups as they are seen in table 17 it is found that these correlation coefficients of table 21 are somewhat lower than are the correlations for the advanced registry groups. They are not low enough, however, to preclude the probability that the difference came from random sampling. Such being the case there seems to be no significant difference between the pedigrees of a random sample of Holstein-Friesian bulls without advanced registry offspring and the Holstein-Friesian bulls with advanced registry offspring.

The results for the study of the sire's and dam's side of the pedigree correspond to those given above.

This analysis shows the utter futility of pedigree analysis like those of Hoven[9] with the Guernseys, unless they are accompanied by an analysis of a random sample of the whole breed.

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[9]Hoven, J. M.
1916. Finding the prepotent sire. Jour. Heredity, vol. 7.

TABLE 21.

Correlation coefficients for the frequency of appearance of the bulls and cows within the pedigrees of the sires of the four following groups (1) sires of daughters with significantly high milk yield, table 9; (2) sires of daughters with significantly low milk yield, table 10; (3) sires of daughters with significantly high butter-fat percentage, table 15; (4) sires of daughters with significantly low butter-fat percentage, table 16; correlated with the frequency of appearance of the animals appearing in the random sample group.

Characters Correlated	Correlation Coefficients	
	Males	Females
Sire's Random Sample and Milk+Sire's Adv. Reg.	+0.314±.041	+0.233±.043
Sire's Random Sample and Milk—Sire's Adv. Reg.	.477±.036	.426±.037
Sire's Random Sample and B.F. %+Sire's Adv. Reg.	.433±.037	.391±.039
Sire's Random Sample and B.F. %—Sire's Adv. Reg.	.336±.041	.321±.041
Sire's Random Sample and Milk+Dam's Adv. Reg.	.504±.034	.375±.039
Sire's Random Sample and Milk—Dam's Adv. Reg.	.170±.045	.311±.041
Sire's Random Sample and B.F. %+Dam's Adv. Reg.	.282±.042	.353±.040
Sire's Random Sample and B.F. %—Dam's Adv. Reg.	.380±.039	.085±.045
Sire's Random Sample and Dam's Random Sample	.492±.035	.393±.039
Dam's Random Sample and Milk+Sire's Adv. Reg.	.165±.045	.170±.044
Dam's Random Sample and Milk—Sire's Adv. Reg.	.398±.039	.509±.034
Dam's Random Sample and B.F. %+Sire's Adv. Reg.	.326±.041	.442±.037
Dam's Random Sample and B.F. %—Sire's Adv. Reg.	.341±.041	.361±.040
Dam's Random Sample and Milk+Dam's Adv. Reg.	.309±.039	.433±.037
Dam's Random Sample and Milk—Dam's Adv. Reg.	.236±.043	.228±.043
Dam's Random Sample and B.F. %+Dam's Adv. Reg.	.282±.042	.374±.039
Dam's Random Sample and B.F. %—Dam's Adv. Reg.	.306±.042	.143±.045
Correlations for each pedigree group without regard to side of pedigree on which the appearance may occur		
Random Sample and Milk+	+0.474±.036	.461±.036
Random Sample and Milk—	.509±.035	.693±.024
Random Sample and B.F. %+	.627±.028	.539±.032
Random Sample and B.F. %—	.459±.036	.392±.039

It counts for naught if a certain number of famous sires belong largely to a particular family if at the same time the same proportion of the sires of the whole breed belong to this family, for surely in such a case the family is only contributing its own share to the whole.

Progeny Performance of Holstein-Friesian Sires' Daughters for Butter-Fat

The butter-fat production of a cow is obtained from the multiplication of the two variables, milk yield and butter-fat percentage. This being the case it follows that an extensive treatment of the milk yield and of the butter-fat percentage largely obviates the necessity of treating the butter-fat in such detail.

The following table gives the average amount of age corrected butter-fat which was produced by the advanced registry daughters of the Holstein-Friesian sires. The first column gives the number in the series of numbers which the mean butter-fat of the sire's daughters takes. The second column gives the name of the bull. The bull's herd book number is given in the third column. The number of daughters is given in the fourth column of the table. The average butter-fat production of the sire's daughters is given in the last column of the table. No octiles are given to show the amount of the production of the daughters. This, as explained above, is unnecessary as they have been given for the two variables, milk yield and butter-fat percentage, on which the butter-fat depends.

It will be noted that King Hengerveld Aaggie Fayne's daughters are the highest butter-fat producers. The record of this bull is of some interest. These three daughters made their records when they were in their first or their second lactation. Their milk yield was high, 2 being in the highest class of milk producers and one in the next to highest. Their butter-fat percentage was very high all three being in the highest class. It is little wonder therefore that these cows have so high an age corrected butter-fat. It is surprising to find, however, that this sire is also the sire of a daughter with a rather poor record of 212 days in length at her 6th year of age. In fact, this record causes a decrease in the average butter-fat produced of over 220 pounds, for the age corrected and length of lactation corrected record.

The records of the 449 sires for butter-fat are given in table 22.

TABLE 22.

Performance of the Progeny of Holstein-Friesian Sires for Butter-Fat.

No.	Name	Herd Book Number	No. of Daughters	Butter-Fat
1	King Hengerveld Aaggie Fayne	56635	3	1278.93
2	Friend Hengerveld DeKol Butter Boy	29303	5	1009.95
3	Iowana Sir Ollie	114797	2	1008.11
4	Cornucopia Waukasha Prince	35119	2	1004.18
5	King Segis Pontiac Count	93909	10	975.82
6	Sir Korndyke Bess	110157	2	975.64
7	Masterpiece	84099	4	940.10
8	Colantha Johanna Champion	45674	4	939.96
9	King Beauty Pietertje DeKol	50758	2	934.42
10	Ormsby Korndyke Lad	102469	4	922.05
11	Sir Pietertje Ormsby Mercedes 14th	81142	2	917.99
12	Cornucopia Pontiac Johanna Lad	48355	2	908.37
13	King Segis Beets	48702	3	901.11
14	White Segis DeKol	78027	2	899.77
15	Spring Farm King Pontiac 6th	103899	5	898.60
16	Aaggie 3d's Wayne's Paul DeKol	27868	4	891.31
17	Pontiac Aaggie Korndyke	38291	14	888.70
18	Maple Crest Pontiac Hartog	62178	5	885.77
19	Piebe Laura Ollie Homestead King	110474	3	884.75
20	Sir Ormsby Skylark	47010	3	879.17
21	Walker Korndyke Segis	50347	2	876.73
22	Wachusett Creamelle George	41803	2	873.66
23	Johanna McKinley Segis	44367	2	872.95
24	Ducthland Sir Pietertje Hengerveld	48696	3	872.45
25	Judge Hengerveld DeKol	43964	2	871.78
26	King Palmyra Fayne	72099	2	870.53
27	Linden Butter Boy Pietertje	54120	3	866.42
28	Korndyke Butter Boy	38496	2	855.53
29	Sindt Butter Boy	55237	3	850.44
30	Count King	59660	2	848.47
31	Homestead Hengerveld Crown DeKol	26345	3	846.41
32	Johanna Rue 3d's Lad	26939	5	843.42
33	Sir Longfield DeKol	36389	4	838.18
34	King of the Pontiacs	39037	37	837.18
35	Sir Johanna Ruth Fayne	53055	2	833.62
36	Sir Inka DeKol Chief	53303	5	833.09
37	Pietertje Hengerveld Sir Korndyke	60966	8	822.99
38	Colantha Johanna Lad	32481	8	822.59
39	Sir Johanna Canary DeKol	44034	3	821.28
40	Pontiac Burke	33979	2	818.49
41	Segis Pontiac DeKol Burke	97472	5	817.53
42	Mooie Fayne DeKol	38505	2	817.48
43	King Walker	40358	8	813.41
44	Mercedes Cornucopia Count	44742	2	812.79
45	Sir Johanna Piebe	53257	13	811.28
46	Johanna Bonheur Champion	94984	2	806.19
47	King Segis Pontiac Alcartra	79602	2	804.69
48	Homestead Girl DeKol Sarcastic Lad	32558	17	795.37
49	Cor-Will Colantha Paul DeKol	52791	3	795.29
50	Sir Pietertje Ormsby Mercedes	44931	36	795.05
51	King Pontiac Champion	53418	20	794.42
52	Duke Ormsby DeKol Creamelle	63578	2	793.93
53	Wit Segis Abbekerk	85556	2	789.43
54	The Milk and Butter King	41114	2	785.64
55	King Mead of Riverside	59290	13	783.26
56	Johanna de Pauline 2d's Lad	28301	4	779.92
57	King of the Black and Whites	83354	2	778.68
58	Quirinus Cornucopia	60751	6	778.62
59	King Segis Pontiac Pietertje	48358	4	777.73
60	Jewel Paul	29463	2	776.93
61	King Pietertje Cloverdale	69686	4	776.20
62	Paul Beets DeKol	22235	3	774.10
63	Prince Johanna DeKol	31168	2	772.46
64	McKinley Hengerveld DeKol	51505	2	771.57

Performance of the Progeny of Holstein-Friesian Sires for Milk Production.—Continued.

No.	Name	Herd Book Number	No. of Daughters	Butter-Fat
65	Sir Paul Veeman Hengerveld	94217	7	770.72
66	Sir Concordia Korndyke	75012	5	770.68
67	Sir Veeman Hengerveld	36158	5	770.47
68	Juliana King of Riverside	38446	8	767.88
69	Rose Hall Pontiac Pietertje	59959	2	766.33
70	Korndyke Netherland Wayne DeKol	47316	2	761.75
71	King Segis Pontiac Witkop	53918	2	760.48
72	DeKol 2d's Butter Boy 3d	23260	8	760.08
73	Prince Gelsche Walker	81663	6	757.85
74	King Pontiac Portia	63895	2	754.45
75	Sir Johanna Aaggie Posch 4th	72013	2	750.66
76	Sir Daisy Mercedes DeKol (Twin)	28982	2	750.40
77	Piebe Champion	60577	5	750.29
78	Aralia DeKol Pontiac Segis	112077	2	749.23
79	Upland Johanna DeKol	57256	2	748.03
80	Sir Clyde	29236	2	742.72
81	Gem Pietertje Paul DeKol	27282	2	741.52
82	Sir Jolie Johanna	36664	3	741.49
83	Greenwood Johanna Lyons	62049	2	741.33
84	DeKol 2d's Mutual Paul	25700	2	740.67
85	Beauty Pietertje Prince	56435	4	740.65
86	Joseph Prilly	51078	3	740.47
87	Tehee Lilith Pauline DeKol	36636	2	739.39
88	Prince Ormsby Mercedes DeKol	47008	3	739.38
89	Pride DeKol of Wayside	45805	2	739.01
90	Hazelwood Korndyke Gerben	98963	2	738.87
91	Sir Jewel Parthenea Docde	38639	3	738.48
92	Emblagaard Prince	80596	4	738.07
93	Aralia King	86837	5	737.77
94	Woodcrest Hengerveld DeKol	46514	2	735.63
95	Prince Alcartra Korndyke	88318	5	735.48
96	Sir Duke Walker	71158	4	735.26
97	Johanna Colantha's Lad	28296	4	733.51
98	Sir Hengerveld Model Johanna	40338	10	732.77
99	Aaggie Cornucopia Pauline Count 13th	44293	10	732.53
100	Prince Pietertje Beryl	46977	3	732.41
101	Aaggie Grace Sir Butter Boy	62239	3	730.64
102	Hengerveld DeKol	23102	5	728.78
103	Dutchland Colantha Sir Inka	50999	19	725.94
104	Oak DeKol Ollie Homestead	85529	3	723.32
105	Segis Pontiac Pauline Count	57188	2	721.50
106	Admiral Walker Pietertje	35269	12	719.52
107	Butter Boy Sir Mechthilde	37302	3	719.18
108	Dutchland Sir Mercena Rag Apple	51002	2	719.16
109	Korndyke Abbekerk	34503	4	715.64
110	Pontiac Korndyke	25982	7	715.32
111	Johanna Colantha Sarcastic Lad	38402	9	714.87
112	Prince Nudine DeKol 2d Aaggie	62483	2	714.72
113	Anselmo	41866	2	713.85
114	Korndyke Queen DeKol's Prince	26025	9	710.90
115	Wisconsin Bess Mooie DeKol	40248	2	710.64
116	Chief of Crown Hill	39314	2	707.94
117	Aaggie Cornucopia Johanna Lad Jr.	36974	9	707.63
118	Lilith Pauline DeKol's Count	28430	3	702.77
119	Sir Johanna Fayne	42147	18	701.81
120	Ignaro DeKol	23538	12	700.18
121	Johanna Sarcastic Paul	30551	2	700.10
122	Sir Korndyke Hengerveld DeKol 36th	85968	3	698.74
123	Pietj Burke	58313	4	698.48
124	Paul Rijaneta 2d	25166	3	698.13
125	King Ormsby	54424	3	693.72
126	Major Spofford Corona	42729	2	692.24
127	Sir Piebe Aaggie Hengerveld	32492	10	692.08
128	Emblagaard Tritomia Homestead	62924	12	691.59
129	King of the Hengervelds	44465	2	691.05
130	Virginia Korndyke Butter Boy	128445	2	690.99

Performance of the Progeny of Holstein-Friesian Sires for Milk Production.—Continued.

No.	Name	Herd Book Number	No. of Daughters	Butter-Fat
131	Vale Mercedes Posch	41416	5	689.44
132	Sir Ybma Spofford Pledge	39074	4	689.42
133	Zady Bergsma Butter Boy	28504	3	688.80
134	Rag Apple Korndyke 8th	73416	3	688.64
135	Woodcrest Tehee	74219	13	687.41
136	Count Pietertje Hengerveld DeKol	41757	2	686.47
137	Pride of Maplehurst Roe	44085	2	686.30
138	Pontiac Hesseltje Korndyke	31438	5	686.26
139	Paul DeKol 3d	22894	2	684.40
140	Sir Challenge Diamond Beauty	57908	3	683.58
141	Aaggie Cornucopia 3d's Lilith	34467	5	683.56
142	Alcartra Polkadot Corrector	30624	13	680.51
143	Aaggie Cornucopia Johanna Lad	32554	3	679.89
144	Paul Piebe DeKol	32059	3	679.69
145	Duchess Ormsby Butter King	30190	3	679.38
146	Sir Johanna Bonheur Fayne	45671	7	678.12
147	Spring Brook Hengerveld Parthenea	68946	4	677.76
148	DeKol Spofford Promise	40207	3	677.38
149	Sir Princess Johanna	57926	2	676.94
150	Pontiac Cornucopia Coronis	51148	2	676.49
151	Mechthilde DeKol Pietertje Paul	29548	2	676.38
152	DeKol Butter Boy Prince	30369	4	676.38
153	Ladoga King Veeman DeKol	43496	3	676.27
154	Lorena Korndyke	81497	2	674.94
155	Johanna Rue Sarcastic Lad	34990	4	673.81
156	Riverside King	49207	2	673.73
157	Lad of Home Farm	33642	2	673.66
158	Sir Johanna Aaggie Posch	38401	7	673.09
159	Prince Leo Aaltje	61435	3	673.04
160	Belle Korndyke Beryl Wayne	32386	2	672.99
161	Maplecrest Butter Boy DeKol	94156	2	672.61
162	Inka Mechthilde Prince	29214	2	672.55
163	Canary Mercedes Pietertje Hartog 6th	78123	2	672.53
164	Crown Pauline Sir Hengerveld	41038	2	671.53
165	Gordon Glen Hengerveld DeKol	52410	3	671.44
166	Gem Pietertje Paul DeKol 3d	44658	7	671.40
167	Sir Johanna Korndyke	42940	8	670.47
168	Prince De Haan Butter Boy	35074	2	669.97
169	King Pontiac Ruby Burke	58041	5	669.71
170	Pontiac Cronus	28835	4	668.46
171	Sir Johanna DeKol Rue	33437	4	668.16
172	King Ormsby Parthenea	81630	5	668.08
173	Johanna Pontiac DeKol	41980	5	668.04
174	Korndyke Hengerveld Gerben DeKol	50361	3	667.65
175	Tidy Abbekerk Prince	37770	5	667.22
176	Prince Homestead DeKol	34944	6	666.64
177	Sir Forrisy DeKol Paul	40492	4	666.32
178	Tirania Lady Colantha Hero	35250	2	664.71
179	DeKol Clothilde Artis	28340	4	664.66
180	Sir Gerben Pietertje	40214	2	664.65
181	Sir Fayne Concordia	35227	8	664.10
182	Sir Winana Beets Segis	52927	6	663.98
183	King Pontiac Netherland	50865	2	663.11
184	Sir Urmagel Burke	58219	5	663.08
185	Sir Pontiac Beets Korndyke	37200	2	662.96
186	Cornelia King	86166	3	662.74
187	King Segis Hengerveld Vale	60344	8	662.64
188	Sir Johanna Rue DeKol	31387	2	662.24
189	Prex Korndyke DeKol	35900	2	660.62
190	Cornucopia Monarch Vale	59156	2	660.20
191	DeKol 2d's Paul DeKol No. 2	23366	2	659.14
192	Oakland Paul Beets Burke	53309	2	656.78
193	Sir Korndyke Hengerveld DeKol	41266	11	655.59
194	Sir Kaan Jewel Mercedes	43666	2	655.07
195	DeKol Creamelle Pontiac Butter Boy	48498	4	654.64

Performance of the Progeny of Holstein-Friesian Sires for Milk Production.—Continued.

No.	Name	Herd Book Number	No. of Daughters	Butter-Fat
196	Sir Johanna DeKol 19th	64143	4	654.57
197	Beauty Walker Pietertje King	84482	3	654.55
198	Woodcrest Pietje	35469	2	654.22
199	Pietertje Hengerveld Segis	44781	3	652.59
200	Pietje 22d's Woodcrest Lad	39849	2	651.82
201	Canary Mercedes Paul	29600	6	650.94
202	Johan Uilkje Lad	37852	2	650.91
203	DeKol 2d's Paul DeKol No. 5	25049	2	650.51
204	Pearl of the Dairy's Joe DeKol	23450	9	649.43
205	Sir Korndyke Queen	55993	9	649.19
206	Sir Johanna Geneora	53399	2	648.35
207	King Pontiac Artis	63994	3	646.95
208	Christmas Pontiac King	52983	3	646.46
209	Sadie Vale Concordia's Paul DeKol 3d	33661	2	646.33
210	Norwood Veeman Hengerveld DeKol	65916	2	646.17
211	Beryl Wayne Korndyke of Riverside	32322	5	645.57
212	Sir Lilith Posch	42682	3	645.51
213	Pontiac Zephyrus	39426	4	645.49
214	Duchess Ormsby Prince	25796	2	644.60
215	Hillside Vale	41751	5	644.12
216	Sir Johanna Vernon DeKol	37439	2	643.64
217	Hazelwood Sir Ormsby	77572	2	643.52
218	Fayne Sir Mutual DeKol	38243	3	642.41
219	Johanna De Colantha Champion	60574	13	641.93
220	Fobes Tritomia Mutual DeKol	40534	6	641.82
221	Canary Paul	48328	6	640.49
222	Cornucopia Hengerveld DeKol	49221	3	640.40
223	Sir Piebe DeKol Ringwood	31215	2	640.25
224	Plum Hengerveld DeKol	27141	2	640.07
225	Mutual Piebe DeKol	44554	8	639.85
226	Hengerveld Soldene Washington	107891	3	639.48
227	Jewel Paul 13th	58769	3	639.21
228	Redbud Cornucopia DeKol King	93229	5	638.78
229	Romeo Aaggie Acme of Riverside	32422	6	638.78
230	A & G Netherland Maud Piebe DeKol	32510	2	638.08
231	Alma Prince Jewel	32731	3	637.50
232	Brom Bones	35903	4	637.27
233	Duke Koningen	24819	2	637.10
234	Minnie Hark Prince Korndyke	41660	2	637.05
235	North Star Longfield Sir Beets	97403	2	636.88
236	Sir Johanna DeKol	25467	14	636.88
237	Junior DeKol (Twin)	30830	2	636.56
238	Prince Ybma Spofford 6th	47135	3	635.41
239	Colantha 4th's Lad	26940	6	635.28
240	DeKol Hengerveld Burke	29737	2	635.01
241	Sir Cornucopia Prince	48663	6	633.76
242	Prince Beauty Pietertje Hartog	45074	3	632.54
243	Riverview Hengerveld	93371	2	631.78
244	Colantha Hartog Pietertje	96076	2	631.48
245	Gerster 7th's Hero	35165	4	630.66
246	Yakima Cornucopia	36220	3	629.63
247	Minnie Sandes 2d's Sir Piebe DeKol	29500	4	629.38
248	King Pontiac Shadeland	113938	2	629.38
249	Aaggie Cornucopia Johanna Lad Jr. 5th	60529	4	628.76
250	King Oak Grove	42235	4	628.29
251	Nieta Pauline Duke	40386	2	628.02
252	Butter Boy Mercedes Prince	30139	2	627.63
253	Sir Johanna Friend Clothilde	26937	3	627.53
254	St. Paul DeKol	31338	3	626.63
255	Johan Woodcrest Lad	52145	5	625.25
256	Segis DeKol Korndyke Prince	31846	2	624.39
257	Hengerveld Homestead DeKol	93149	2	624.26
258	Madge Prince Hartog	56632	2	622.79
259	DeKol Burke	22991	8	622.28
260	Kalmuck Skylark Johanna	48832	4	621.69

Performance of the Progeny of Holstein-Friesian Sires for Milk Production.—Continued.

No.	Name	Herd Book Number	No. of Daughters	Butter-Fat
261	Sir Pietertje Lass DeKol	94292	5	621.29
262	Count Aaggie Netherland DeKol	35887	3	619.58
263	Pabst Pontiac Champion	105106	2	618.84
264	Junior Concordia DeKol	35975	2	617.76
265	King Segis Pontiac Emperor	72287	2	616.98
266	Aaggie Cornucopia Pauline Count 7th	44758	3	616.96
267	Prince Leila DeKol	29358	3	616.71
268	Pontiac Hengerveld Parthenea	39972	7	616.02
269	Dutchland Sir Pontiac Rag Apple	47282	4	615.33
270	Sir Hengerveld DeKol Ormsby (Twin)	31211	4	614.70
271	Sir William Prince	37226	3	614.30
272	Agatha Netherland Pietertje	26980	2	613.41
273	Knight Errant	39566	3	612.58
274	Sir Mercedes DeKol Pet	34205	2	610.76
275	Sir Pietertje Korndyke Hengerveld	74982	2	609.26
276	Tina Clay Johanna	38214	6	608.17
277	Aaltje Salo Mercedes DeKol Prince	39357	8	607.78
278	Sir Johephine Mechthilde Pietertje	32110	2	607.77
279	King Soldene Butterfly	91668	2	607.58
280	King Koningen DeKol	29813	2	606.79
281	Dichter Calamity Segis DeKol	59219	2	606.25
282	Sir Piebe Johanna Sarcastic	37094	4	604.68
283	Oak DeKol 2d Homestead Fobes	65750	3	604.51
284	Johanna DeKol's Lad	26938	20	603.38
285	Homestead Jr. DeKol	28400	3	603.24
286	King Segis Pontiac	44444	5	603.11
287	Beechwood Sir Josephine	26734	2	602.70
288	Sir Colantha Juliana 2d	98762	2	601.11
289	DeKol Pietertje Prince 2d	27930	2	600.77
290	Almeda Luecke 2d's Son	30266	2	600.71
291	Paul Hengerveld DeKol Concordia	36632	2	599.30
292	Sir Walker Segis	50672	12	599.21
293	Jessie Fobes Tritomia Duke	32254	5	599.14
294	Spring Farm King Pontiac 8th	114319	3	596.60
295	Downing Johanna Burke DeKol	84472	2	595.42
296	Pontiac Cornucopia	38977	2	595.31
297	Missouri Chief Josephine Lad	70857	4	595.25
298	Parthenea Sarcastic	42448	4	594.25
299	Pontiac Hengerveld DeKol	29027	5	593.87
300	Pietje 22d Son	58314	2	592.90
301	Mutual Paul Pietertje DeKol	35911	2	592.68
302	Sir Johanna DeKol Darkness	40871	2	592.32
303	Sir Pontiac Korndyke Pietertje	53618	2	591.51
304	Ianthe Sir Posch	33957	2	589.98
305	Sir Prilly Segis	51510	3	589.69
306	Sir Musser Clyde DeKol	40368	2	589.68
307	Star Farm Johanna Lad	45224	11	588.96
308	Rollingdale Pauline Beets	76861	2	588.40
309	King Champion Victoria	68544	5	587.80
310	Cedar Lawn Sir Johanna	104002	3	587.59
311	Meibloem DeKol	46593	3	585.91
312	Hollins Harlem	49795	2	585.69
313	Judge Beets Segis	51511	2	584.98
314	Paul Cornucopia Mercedes Aaggie	94884	6	583.69
315	Hengerveld DeKol Tromp	81405	3	583.05
316	Mooie Oak DeKol 2d	60278	2	582.99
317	Sir Mooie Oak DeKol	41220	3	582.53
318	Carlotta 2d's Sir Parthenea	454 W.H. F.A.	2	582.41
319	Sir Ormsby Hengerveld DeKol	31212	14	581.31
320	Johanna Fayne Hartog	65981	2	580.77
321	Segis Longfield Homestead	75627	2	579.36
322	Sir Johanna Colantha Concordia	53059	4	577.22
323	Jessie Fobes Mutual	55732	5	577.06
324	Piebe Longfield DeKol	51217	4	576.02
325	Beryl Wayne's Son	30413	2	575.99

Performance of the Progeny of Holstein-Friesian Sires for Milk Production.—Continued.

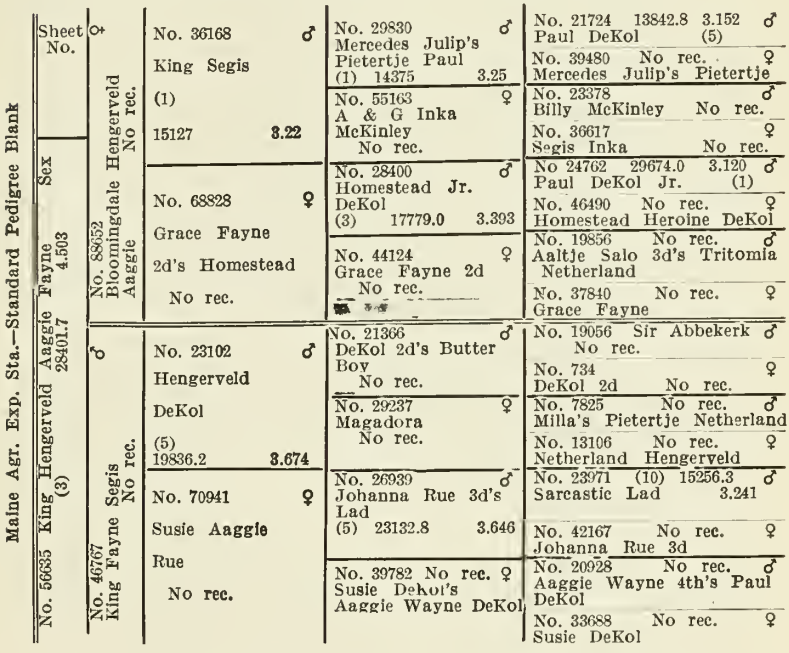
No.	Name	Herd Book Number	No. of Daughters	Butter-Fat
326	Elmwood Sir Hengerveld Segis	71527	2	575.67
327	Arcady Segis Hengerveld Wayne	75304	4	575.60
328	Fobes DeKol Homestead	55736	2	575.39
329	Duchess Ormsby Piebe Burke	29328	4	575.39
330	Gudultje Gerben Sir Fobes	42183	4	575.07
331	Paul Mechthilde DeKol	22233	4	574.28
332	Johanna Bonheur Sir Fayne	46595	2	572.57
333	Duke Fobes	60047	5	572.34
334	Homestead Crown Prince DeKol	25865	4	571.72
335	Prince Inka Pietertje DeKol 2d	22699	3	571.44
336	Johanna Clothilde 3d's Clyde	33550	7	570.40
337	Beppo Jewel Lad	30634	3	569.89
338	Luecke Paul	33289	2	568.95
339	Sir Ormsby DeKol	27284	2	568.22
340	Prince Pietertje Maid	42033	7	568.18
341	King of the Pontiacs 8th	63637	3	567.43
342	Parkside Spofford Lyons DeKol	58322	2	567.42
343	Hygeia Veeman Butter Boy	43697	12	567.08
344	Sir Jolie DeKol	28633	2	566.67
345	Johanna Rue Lad	34989	2	566.57
346	Rag Apple Korndyke DeKol	67211	4	565.11
347	Sir Homestead Posch DeKol	37314	9	564.35
348	Duke Spencer Lyons	45652	2	564.34
349	Pietertje DeKol Paul DeKol	41895	2	563.86
350	Paul Frenesta DeKol	41206	20	563.46
351	Sir Henry Netherland of Hollins	30674	6	563.45
352	Wit Duchess Gem	31208	2	562.91
353	Sir Ormsby Johanna DeKol	37689	2	561.31
354	Sir Colantha Juliana	67203	2	561.18
355	Wooderest Pietje Ormsby	54909	2	559.47
356	Captain Pietertje Barber	41009	2	558.73
357	Aaggie Clothilde Bawn DeKol	33207	3	558.57
358	Sir Pontiac DeKol Burke	50929	2	558.31
359	Creamelle Aaggie Taurus	80551	2	556.65
360	DeKol Paul Cornucopia King	71071	2	555.28
361	Gerben Boelyn	38243	2	553.66
362	Dutchland Sir Korndyke Gladi	48121	2	552.40
363	Tulip Hengerveld DeKol	41562	3	550.65
364	Mutual Friend DeKol Albrice	38979	5	526.69
365	Woodcrest DeKol Burke	40718	2	526.45
366	Pontiac Carlotta Gerben	45807	4	549.48
367	Pietertje Hengerveld Mercena DeKol	42381	2	548.51
368	Samuel DeKol	36903	2	547.03
369	Star Farm Inka Count	53247	2	545.49
370	King Hengerveld Pondyke	47843	8	544.50
371	Homestead Masterpiece Aaggie	59682	6	544.25
372	King Veeman DeKol	36819	3	543.78
373	Sir Korndyke Pontiac Artis	46301	5	543.09
374	Sir Von Harlingen Vernon DeKol	29876	2	540.31
375	Clothilde Chief	20994	2	540.23
376	Paul Jewel DeKol Mechthilde	44916	2	539.22
377	Lakeside Model Alban	71013	2	538.63
378	Joe Pride Aaggie DeKol	66417	2	537.89
379	Sir DeKol Ruth	47341	2	537.32
380	Aaggie Sir Ormsby 2d	54001	2	536.86
381	Gem Segis Beets	52297	2	536.58
382	Hollywood Roselea Palmyra	121546	2	535.97
383	Sir Carlotta Pontiac Cronus	45502	4	534.02
384	Sir Beets Cornucopia Netherland	38460	4	533.33
385	Beryl Wayne DeKol Paul Pietertje	40663	2	533.29
386	Sir Aaggie DeKol Netherland	29588	6	531.19
387	Segis Hengerveld Johanna	76663	3	529.80
388	King Pontiac Dione	82505	11	528.13
389	Sir Beets DeKol Ormsby	46763	2	527.78
390	Hengerveld Butter Boy DeKol	44543	3	527.37

Performance of the Progeny of Holstein-Friesian Sires for Milk Production.—Concluded.

No.	Name	Herd Book Number	No. of Daughters	Butter-Fat
391	Canary Piebe DeKol	35188	2	527.32
392	Korndyke Abbekerk 3d	49288	6	526.60
393	Small Hopes Korndyke DeKol	32260	2	525.18
394	Sir Hubbard Pietertje	48557	2	524.50
395	Woodcrest DeKol Lad	45103	4	523.71
396	Leland Sarcastic	42451	2	523.47
397	Paul Cornucopia America	39904	2	521.85
398	Korndyke Prince Grace DeKol	32655	2	521.44
399	Sunny Jim	38883	2	519.72
400	Dan Patch Hark	37807	2	518.88
401	Jettine's Echo's Mercedes Prince	22499	2	515.57
402	Minnie Hark Pietertje Burke	57476	3	515.26
403	Iowa Ormsby Duke	66092	2	514.99
404	Prince Segis Johanna Korndyke	97224	2	511.33
405	Sunnyside Homestead DeKol	35226	3	510.55
406	King Pietertje Hengerveld Ormsby	107790	2	508.95
407	Johanna DeKol's Lad 2d	60360	2	505.46
408	May Paul DeKol	31957	2	504.55
409	Butter Boy Hengerveld DeKol	24937	3	503.96
410	Lord Indi DeKol	29882	2	503.32
411	Clear View Jimmy Koningen	51067	2	502.22
412	King Segis Hengerveld	51523	3	498.08
413	Johanna Colantha 2d's Sir Fayne	45998	2	497.51
414	Pontiac Arcas	41484	2	494.48
415	Sarcastic Lad	23971	10	494.46
416	Iowana Lad	70753	3	494.04
417	Sir Lilith Pauline Johanna	52527	2	492.77
418	The Milk and Butter King 2d	48846	2	491.18
419	Sir Aaggie Cornucopia Segis	76665	2	490.76
420	Piersma Albina Segis Lad	75361	5	489.90
421	Sir Vale Daisy DeKol Paul	40547	2	489.14
422	Sir College Cornucopia	59755	2	488.56
423	Duke Segis Inka Korndyke	49722	7	488.12
424	King Prilly Pietertje	46212	2	487.03
425	Beryl Wayne Veeman	35431	3	486.29
426	Manor DeKol Wayne	33894	4	486.09
427	Butter Boy Model DeKol	37222	2	485.78
428	Woodcrest Gordon Fayne	97208	4	485.18
429	Hartog Paul Burke	49910	3	483.86
430	Earl Korndyke DeKol	24954	7	482.88
431	Sir Carlotta Pontiac	38652	3	480.09
432	Oak Grove Errant	47808	2	477.89
433	Plum Lad	59272	2	476.08
434	Sir Segis Mutual Walker	80916	4	476.08
435	North Star Johanna DeKol Duke	52163	2	472.72
436	Hollins Hamilton	55819	2	472.12
437	Sir Aaltje Posch	31789	2	469.84
438	Paul Calamo Korndyke 3d	60710	2	468.63
439	Parthenea's Sir Henry 2d	24091	2	465.00
440	Anual's Paul DeKol	26167	2	463.59
441	Inka Jupiter Jr.	43113	2	463.46
442	Sir Drosky Abbekerk	43075	3	459.13
443	Sir Korndyke Hengerveld Canary	53825	6	457.06
444	King Lyons Spofford 3d	75034	2	456.56
445	Gilbert Pauline Paul DeKol	27796	2	445.81
446	Johanna Rue 2d's Paul DeKol	21724	5	436.33
447	Houwtje Portage Paul DeKol	39156	2	433.76
448	Lord Nudine DeKol	35639	3	421.71
449	Manor DeKol's Plum	24777	2	421.39

The pedigree of King Hengerveld Aaggie Fayne is of some interest, since the butter-fat production of the advanced registry daughters of this bull is so high.

Pedigree of King Hengerveld Aaggie Fayne 56635.


Maine Agr. Exp. Sta.—Standard Pedigree Blank
Sheet No.
Sex
No. 56635 King Hengerveld Aaggie Fayne 4.503 28401.7 (3)
No. 88652 Bloomingdale Hengerveld Aaggie No rec.
No. 36168 ♂ King Segis (1) 15127 3.22
No. 68828 ♀ Grace Fayne 2d's Homestead No rec.
No. 46767 King Fayne Segis No rec.
No. 23102 ♂ Hengerveld DeKol (5) 19836.2 3.674
No. 70941 ♀ Susie Aaggie Rue No rec.
No. 29830 ♂ Mercedes Julip's Pietertje Paul (1) 14375 3.25
No. 55163 ♀ A & G Inka McKinley No rec.
No. 28400 ♂ Homestead Jr. DeKol (3) 17779.0 3.393
No. 44124 ♀ Grace Fayne 2d No rec.
No. 21366 ♂ DeKol 2d's Butter Boy No rec.
No. 29237 ♀ Magadora No rec.
No. 26939 ♂ Johanna Rue 3d's Lad (5) 23132.8 3.646
No. 39782 No rec. ♀ Susie Dekol's Aaggie Wayne DeKol
No. 21724 13842.8 3.152 ♂ Paul DeKol (5)
No. 39480 No rec. ♀ Mercedes Julip's Pietertje
No. 23378 ♂ Billy McKinley No rec.
No. 36617 ♀ Segis Inka No rec.
No 24762 29674.0 3.120 ♂ Paul DeKol Jr. (1)
No. 46490 No rec. ♀ Homestead Heroine DeKol
No. 19856 No rec. ♂ Aaltje Salo 3d's Tritomia Netherland
No. 37840 No rec. ♀ Grace Fayne
No. 19056 Sir Abbekerk ♂ No rec.
No. 734 ♀ DeKol 2d No rec.
No. 7825 No rec. ♂ Milla's Pietertje Netherland
No. 13106 No rec. ♀ Netherland Hengerveld
No. 23971 (10) 15256.3 ♂ Sarcastic Lad 3.241
No. 42167 No rec. ♀ Johanna Rue 3d
No. 20928 No rec. ♂ Aaggie Wayne 4th's Paul DeKol
No. 33688 No rec. ♀ Susie DeKol

The figures for the cows give the milk production and the butter-fat percentage of these cows. The figures for the bulls give the number of his daughters (in the circle) and the average milk yield and butter-fat percentage of these daughters. Examination of this pedigree does not impress one as containing enough high record animals to make so productive a sire as King Hengerveld Aaggie Fayne. It will be noted that there are many animals who do not have records. In fact not a single dam in this pedigree has a year record. Such being the case, the productive powers of this sire's daughters may be due to their dams or it may be that this sire transmits the high milk yield and butter-fat percentage of the parents for which no year record is known.

The average butter-fat production of the daughters of the sires contained in table 22 range from 1278.93 pounds to 421.39 pounds. It will be noted that the first sire is considerably above the others in his daughters' average. The jump from the highest to the next to the highest bull is quite abrupt. From the second bull the decline is more gradual. It will be noted that the lower limit of these sires' daughters production is 421.39 pounds. This is almost 60 pounds above the requirement for entry.

The bulls which sired daughters with butter-fat records significantly higher than the breed as a whole are given below. These sires are chosen in the same manner as in the previous tables. The record to be considered significant must be three times the probable error more than the average butter-fat yield of the breed. This probable error for the different numbers of daughters is shown in table 5.

1	King Hengerveld Aaggie Fayne	Quite significant
2	Friend Hengerveld DeKol Butter Boy	Quite significant
3	Iowana Sir Ollie	Significant
4	Cornucopia Waukasha Prince	Significant
5	King Segis Pontiac Count	Quite significant
6	Sir Korndyke Bess	Significant
7	Masterpiece	Significant
8	Colantha Johanna Champion	Significant
9	King Beauty Pietertje DeKol	Significant
10	Ormsby Korndyke Lad	Significant
11	Sir Pietertje Ormsby Mercedes 14th	Significant
12	Cornucopia Pontiac Johanna Lad	Significant
13	King Segis Beets	Significant
14	White Segis DeKol	Significant
15	Spring Farm King Pontiac 6th	Significant
16	Aaggie 3d's Wayne's Paul DeKol	Significant
17	Pontiac Aaggie Korndyke	Quite significant
18	Maple Crest Pontiac Hartog	Significant
19	Piebe Laura Ollie Homestead King	Significant
20	Sir Ormsby Skylark	Significant
24	Dutchland Sir Pietertje Hengerveld	Significant
27	Linden Butter Boy Pietertje	Significant
29	Sindt Butter Boy	Significant
31	Homestead Hengerveld Crown DeKol	Significant
32	Johanna Rue 3d's Lad	Significant
33	Sir Longfield DeKol	Significant
34	King of the Pontiacs	Quite significant
36	Sir Inka DeKol Chief	Significant

37	Pietertje Hengerveld Sir Korndyke	Significant
38	Colantha Johanna Lad	Significant
41	Segis Pontiac DeKol Burke	Significant
43	King Walker	Significant
45	Sir Johanna Piebe	Significant
48	Homestead Girl DeKol Sarcastic Lad	Significant
50	Sir Pietertje Ormsby Mercedes	Significant
51	King Pontiac Champion	Significant
55	King Mead of Riverside	Significant

The number at the left of the name is the same as that in table 22. The name is followed by the significance to be attached to the record. Those recorded as "quite significant" have a butter-fat record sufficiently large and enough different daughters so that the record is surely significantly different from the average of the Holstein-Friesian breed. Those sires marked as "significant" have daughters who probably are greater producers on the average than the rest of the breed.

It will be noted that there are five sires who have sired daughters which have a high average in their butter-fat yield as compared with the rest of the breed. These sires are King Hengerveld Aaggie Fayne, Friend Hengerveld DeKol Butter Boy, King Segis Pontiac Count, Pontiac Aaggie Korndyke and King of the Pontiacs.

There are 37 sires in all who have daughters which are significantly above those cows in the rest of the breed. These sires have sired 271 daughters who have records in the advanced registry.

The sires who have daughters significantly inferior in their butter-fat production to the rest of the Holstein-Friesian breed are obtained in a similar manner to those which are superior in this respect. The list of these sires is given below.

449	Manor DeKol's Plum	Significant
448	Lord Nudine DeKol	Significant
447	Houwtje Portage Paul DeKol	Significant
446	Johanna Rue 2d's Paul DeKol	Significant
443	Sir Korndyke Hengerveld Canary	Significant
442	Sir Drosky Abbekerk	Significant
435	Sir Segis Mutual Walker	Significant
432	Sir Carlotta Pontiac	Significant
431	Earl Korndyke DeKol	Significant
429	Woodcrest Gordon Fayne	Significant
427	Manor DeKol Wayne	Significant

424	Duke Segis Inka Korndyke	Significant
420	Piersma Albina Segis Lad	Significant
415	Sarcastic Lad	Significant
392	Korndyke Abbekerk 3d	Significant
388	King Pontiac Dione	Significant
386	Sir Aaggie DeKol Netherland	Significant
370	King Hengerveld Pondyke	Significant
350	Paul Frenesta DeKol	Significant
343	Hygeia Veeman Butter Boy	Significant

The arrangement of this list is similar to the preceding one. The number at the left represents the position taken by the sire in table 22. There is no sire in this list of sires which is more than significantly below the average of the breed.

There are 20 of these sires which have their daughters' butter-fat yield significantly below the average of the Holstein-Friesian advanced registry cows. It will be remembered that there are 37 sires who have daughters which are superior to the others of the race. This difference is favorable to the breed's improvement. Unfortunately, it by no means tells the whole story, for as pointed out earlier the relatively low number of poorer sires may be accounted for by the requirement for entry in the advanced registry.

PROGENY PERFORMANCE FOR HOLSTEIN-FRIESIAN SIRES' SONS FOR MILK YIELD, BUTTER-FAT PERCENTAGE AND BUTTER-FAT OF THEIR DAUGHTERS.

In this section we deal with the sire, the sons of which have advanced registry daughters with year tests. For this purpose the bulls of a given sire are collected under his name together with the average milk yield, butter-fat percentage and butter-fat of the bulls' daughters. Table 23 presents this information for those sires who have progeny tested sons. The table is arranged to show the average butter-fat of these sires' sons' daughters, the highest being first, the next most productive following, and so on, until the lowest producer is reached. The average or mean is taken for each sire who has more than one son.

The number at the left of the table gives the position of the given sire in the list of the 244 sires as regards his sons' daughters' average butter-fat. The name of the sire follows this num-

ber. The sire's number is given in the third column. The fourth, fifth, sixth and seventh columns give the number of daughters' average milk yield, butter-fat percentage and butter-fat of the sires' daughters, if he has such in the advanced registry. Immediately below the sire's name slightly indented from it appear the sons' names. On the same line as the sons' names and at the right are given the sons' Herd book numbers, the number of his year test daughters and their average milk yield, butter-fat percentage and butter-fat. The average or mean milk yield, butter-fat percentage and butter-fat of these sires' sons' daughters appear immediately below the records of these sons.

TABLE 23.

Performance of the Progeny of the Sons of Holstein-Friesian Sires for Milk Yield, Butter-Fat Percentage and Butter-Fat.

No.	Name of Sire and Sons	No. H.B.	Daugh- No. of ters	Yield Milk	B.F. %	Fat Butter-
1	King Fayne Segis	46767				
	King Hengerveld Aaggie Fayne	56635	3	28401.7	4.503	1278.93
	King Palmyra Fayne	72099	2	27035.0	3.220	870.53
	Masterpiece	84099	4	26186.5	3.590	940.10
	Mean			27207.7	3.771	1029.85
2	Canary Paul Fobes Homestead	65751				
	Iowana Sir Ollie	114797	2	26459.5	3.810	1008.11
3	Sir Korndyke Hengerveld DeKol 36th	85968	3	20235.7	3.453	698.74
	Sir Korndyke Bess	110157	2	25948.0	3.760	975.64
4	Royal DeKol Pietertje King	41296				
	King Beauty Pietertje DeKol	50758	2	23537.0	3.970	934.42
5	King Korndyke Hengerveld Ormsby	53822				
	Ormsby Korndyke Lad	102469	4	25626.8	3.598	922.05
6	Crown Prince Segis	52348				
	White Segis DeKol	78927	2	26899.0	3.345	899.77
7	Pontiac Aaggie Korndyke	38291	14	22787.1	3.900	888.70
	Maple Crest Pontiac Hartog	62178	5	22584.6	3.922	885.77
8	Oak DeKol Ollie Homestead	85529	3	20549.0	3.520	723.32
	Piebe Laura Ollie Homestead King	110474	3	28384.7	3.117	884.75
9	Creamelle DeKol Butter Boy	29925				
	Wachusett Creamelle George	41803	2	26474.5	3.300	873.66
10	Faforit Tritomia Sir Korndyke	36324				
	Pietertje Hengerveld Sir Korndyke	60966	8	24327.1	3.383	822.99
11	Duchess Ormsby Butter King	30190	3	19483.3	3.487	679.38
	Pontiac Burke	33979	2	24954.0	3.280	818.49
12	Admiral Walker Pietertje	35269	12	20505.0	3.509	719.52
	King Walker	40358	8	23797.9	3.418	813.41
13	Cornucopia Waukasha Prince	35119	2	27030.5	3.715	1004.18
	Mercedes Cornucopia Count	44742	2	24408.0	3.330	812.79
14	Sir Johanna Ruth	42142				
	Sir Johanna Piebe	53257	13	22516.8	3.603	811.28
15	Gerben Colantha Lad	36448				
	Cor-Will Colantha Paul DeKol	52791	3	22985.3	3.460	795.29
16	Jack Mercedes	35077				
	Sir Pietertje Ormsby Mercedes	44931	36	21681.3	3.667	795.05
17	Duke Ormsby DeKol	31038				
	Duke Ormsby DeKol Creamelle	63578	2	27143.0	2.925	793.93

Performance of the Progeny of the Sons of Holstein-Friesian Sires for Milk Yield, Butter-Fat Percentage and Butter-Fat.—Continued.

No.	Name of Sire and Sons	H.B. No.	No. of Daughters	Milk Yield	B.F. %	Butter-Fat
18	King Walker	40358	8	23797.9	3.418	813.41
	Count King	59660	2	25595.0	3.315	848.47
	Sir Duke Walker	71158	4	21140.3	3.478	735.26
	Mean			23367.7	3.397	791.87
19	Prince Segis Rauwerd	51253				
	Wit Segis Abbekerk	85556	2	26183.5	3.015	789.43
20	King Segis Pontiac Emperor	72287	2	19101.5	3.230	616.98
	Segis Pontiac DeKol Burke	97472	5	23600.8	3.464	817.53
	Aralia DeKol Pontiac Segis	112077	2	21560.5	3.475	749.23
	Mean			22580.7	2.313	783.38
21	Sir Tehee Cornucopia	38978				
	Quirinus Cornucopia	60751	6	22954.5	3.392	778.62
22	Springvale Duchess 2d's Paul	28428				
	Jewel Paul	29463	2	21824.0	3.560	776.93
23	Judge Hengerveld DeKol	43964	2	23063.0	3.780	871.78
	McKinley Hengerveld DeKol	51505	2	18525.0	4.165	771.57
24	Sir Veeman Hengerveld	36158	5	20948.0	3.678	770.47
	Sir Paul Veeman Hengerveld	94217	7	21063.6	3.659	770.72
25	Concordia Korndyke Alban	41174				
	Sir Concordia Korndyke	75012	5	24780.6	3.110	770.68
26	Fidessa Butter Boy	32429				
	Juliana King of Riverside	38446	8	20325.0	3.778	767.88
27	Sir Pietertje Ormsby Mercedes	44931	36	21681.3	3.667	795.05
	Sir Pietertje Korndyke Hengerveld	74982	2	17066.0	3.570	609.26
	Sir Pietertje Ormsby Mercedes 14th	81142	2	24844.0	3.695	917.99
	Mean			20955.0	3.633	763.63
28	Beauty Pietertje Prince	56435	4	21480.3	3.448	740.64
	Prince Gelsche Walker	81663	6	22401.7	3.383	757.85
29	Sir Johana Aaggie Posch	38401	7	18425.6	3.653	673.09
	Sir Johanna Aaggie Posch 4th	72013	2	21478.0	3.495	750.66
30	Johanna Paul Sarcastic Lad	48041				
	Upland Johanna DeKol	57256	2	23486.0	3.185	748.03
31	Spring Farm King Pontiac	66664				
	Spring Farm King Pontiac 6th	103899	5	25956.0	3.462	898.60
	Spring Farm King Pontiac 8th	114319	3	17531.7	3.403	596.60
	Mean			21743.9	3.433	747.60
32	DeKol 2d's Butter Boy 3d	28269	8	21501.6	3.535	760.08
	Homestead Hengerveld Crown DeKol	26345	3	21888.0	3.867	846.41
	DeKol Clothilde Artis	28340	4	20482.5	3.245	664.66
	Zady Bergsma Butter Boy	28504	3	18112.0	3.803	688.80
	Friend Hengerveld DeKol Butter Boy	29303	5	25516.6	3.958	1009.95
	DeKol Hengerveld Burke	29737	2	16755.0	3.790	635.01
	DeKol Butter Boy Prince	30369	4	19645.0	3.443	676.38
	Prince De Haan Butter Boy	35074	2	20029.0	3.345	669.97
	Korndyke Butter Boy	38496	2	23699.0	3.610	855.53
	Hygeia Veeman Butter Boy	43697	12	15920.4	3.562	567.08
	Sindt Butter Boy	55237	3	22861.3	3.720	850.44
	Mean			20490.0	3.634	746.42
33	Canary's Mercedes' Royal Sirocco	22450				
	Sir Clyde	29236	2	20775.5	3.575	742.72
34	Johanna DeKol 2d's Lad	26936				
	Sir Jolie Johanna	36664	3	25367.3	2.923	741.49
35	Mutual Friend 3d's Paul	23200				
	DeKol 2d's Mutual Paul	25700	2	22650.5	3.270	740.67
36	Joe Gelsche DeKol Burke	38391				
	Joseph Prilly	51078	3	20876.0	3.547	740.47
37	Netherland Bessie Paul DeKol	34617				
	Pride DeKol of Wayside	45805	2	22669.0	3.260	739.01
38	Sir Korndyke Hengerveld DeKol 11th	61271				
	Hazelwood Korndyke Gerben	98063	2	21957.5	3.365	738.87
39	Canary Mercedes Paul	29600	6	17799.7	3.657	650.94
	Sir Kaan Jewel Mercedes	43666	2	18851.0	3.475	655.07
	Sir Johanna Canary DeKol	44034	3	22275.0	3.687	821.28
	Mean			20563.0	3.581	738.18

Performance of the Progeny of the Sons of Holstein-Friesian Sires for Milk Yield, Butter-Fat Percentage and Butter-Fat.—Continued.

No.	Name of Sire and Sons	H.B. No.	No. of Daughters	Milk Yield	B.F. %	Butter-Fat
40	Almeda Luecke 2d's Piebe DeKol	28660				
	A. & G. Netherland Maud Piebe DeKol	32510	2	17315.5	3.685	638.08
	Sir Longfield DeKol	36380	4	24051.0	3.485	838.18
	Mean			20683.3	3.585	738.13
41	King Segis Pontiac	44444	5	17512.0	3.444	603.11
	King Segis Pontiac Witkop	53918	2	21124.5	3.600	760.48
	King Segis Pontiac Emperor	72287	2	19101.5	3.230	616.98
	King Segis Pontiac Aleartra	79602	2	23494.5	3.425	804.69
	King Pontiac Dione	82505	11	15442.4	3.420	528.13
	King Segis Pontiac Count	93909	10	28219.1	3.458	975.82
	Mean			21476.4	3.427	737.22
42	Colantha Johanna Champion	45674	4	26894.5	3.495	939.96
	Johanna De Colantha Champion	60574	13	18510.2	3.468	641.93
	Piebe Champion	60577	5	23057.4	3.254	750.29
	Johanna Bonheur Champion	94984	2	25233.0	3.195	806.19
	Mean			22266.9	3.306	732.80
43	Pontiac Korndyke	25982	7	19743.9	3.623	715.32
	Pontiac Hesseltje Korndyke	31438	5	19562.6	3.508	686.26
	Korndyke Abbekerk	34503	4	21555.3	3.320	715.64
	Pontiac Aaggie Korndyke	38291	14	22787.1	3.900	888.70
	King of the Pontiacs	39037	37	22182.7	3.774	837.18
	Dutchland Sir Pontiac Rag Apple	47282	4	18368.0	3.350	615.33
	Sir Korndyke Queen	55993	9	18757.4	3.461	649.19
	Mean			20535.5	3.552	732.05
44	Aaggie Grace Butter Boy	34389				
	Aaggie Grace Sir Butter Boy	62239	3	22904.0	3.199	730.64
45	Juliana King of Riverside	38446	8	20325.0	3.778	767.88
	Riverside King	49207	2	22053.5	3.055	673.73
	King Mead of Riverside	50290	13	19754.3	3.965	783.26
	Mean			20903.9	3.510	728.50
46	Colantha Johanna Lad	32481	8	24732.1	3.326	822.59
	Dutchland Colantha Sir Inka	50999	19	21182.9	3.427	725.94
47	Oak DeKol 2d Homestead Fobes	65750	3	19252.0	3.140	604.51
	Oak DeKol Ollie Homestead	85529	3	20549.0	3.520	723.32
48	Sir Pontiac King Segis	40751				
	Segis Pontiac Pauline Count	57188	2	21569.5	3.345	721.59
49	Inka Clothilde Mercedes Prince	32242				
	Aaltje Salo Mercedes DeKol Prince	39357	8	17642.3	3.445	607.78
	Sir Inka DeKol Chief	53303	5	19882.8	4.190	833.09
	Mean			18762.6	3.818	720.44
50	Admiral Walker	25755				
	Admiral Walker Pietertje	35269	12	20505.0	3.509	719.52
51	Dutchland Sir Pontiac Rag Apple	47282	4	18368.5	3.350	615.33
	Dutchland Sir Mercena Rag Apple	51002	2	19676.0	3.655	719.16
52	Korndyke Wayne Paul DeKol	32571				
	Sir Johanna Korndyke	42940	8	18389.3	3.646	670.47
	Korndyke Netherland Wayne DeKol	47306	2	22016.0	3.469	761.75
	Mean			20292.7	3.580	716.11
53	Manor Josephine DeKol	22779				
	Pontiac Korndyke	25982	7	19743.9	3.623	715.32
54	Prince Nudine DeKol 2d	45903				
	Prince Nudine DeKol 2d Aaggie	62483	2	21991.5	3.250	714.72
55	Ichabod Crane Jr.	35178				
	Anselmo	41866	2	21964.5	3.250	713.85
56	Lorraine Prince	25169				
	Korndyke Queen DeKol's Prince	26025	9	20915.0	3.399	710.90
57	Jessie Fobes Tritomia Improver	31074				
	Chief of Crown Hill	39314	2	20700.0	3.420	707.94
58	King Colantha Clothilde	60403				
	Emblagaard Prince	80596	4	25512.3	2.893	738.07
	King of the Black & Whites	83354	2	24564.0	3.170	778.68
	Beauty Walker Pietertje King	84482	3	19983.0	3.430	654.55
	Colantha Hartog Pietertje	96076	2	20592.5	3.080	631.48
	Mean			22415.5	3.143	706.75

Performance of the Progeny of the Sons of Holstein-Friesian Sires for Milk Yield, Butter-Fat Percentage and Butter-Fat.—Continued.

No.	Name of Sire and Sons	H.B. No.	No. of Daughters	Milk Yield	B.F. %	Butter-Fat
59	Pauline Paul 2d's Count	22909				
	Lilith Pauline DeKol's Count	28430	3	20136.7	3.490	702.77
60	Paul DeKol 3d	22894	2	21026.9	3.255	684.40
	Aaggie 3d's Wayne's Paul DeKol	27868	4	24154.8	3.690	891.31
	Sir Veeman Hengerveld	36158	5	20948.0	3.678	770.47
	Paul Hengerveld DeKol Concordia	36632	2	19553.0	3.065	599.30
	King Veeman DeKol	36819	3	17712.7	3.070	543.78
	Mean			20592.1	3.376	701.22
61	Johanna 5th's Paul DeKol	22372				
	Ignaro DeKol	23538	12	21650.5	3.234	700.18
62	Sir Homestead Posch DeKol	37314	9	16618.1	3.396	564.35
	King Pietertje Cloverdale	69686	4	23428.8	3.313	776.20
	Sir Pietertje Lass DeKol	94292	5	18907.2	3.286	621.29
	Mean			21168.0	3.300	698.75
63	Paul Rijaneta	20919				
	Paul Rijaneta 2d	25166	3	20159.7	3.463	698.13
64	King of the Pontiacs	39037	37	22182.7	3.774	837.18
	King Hengerveld Pondyke	47843	8	15079.0	3.611	544.50
	Cornucopia Pontiac Johanna Lad	48355	2	27821.5	3.265	908.37
	King Pontiac Netherland	50865	2	19137.5	3.465	663.11
	King Pontiac Champion	53418	20	22620.3	3.512	794.42
	King Pontiac Ruby Burke	58041	5	19513.8	3.432	669.71
	Rose Hall Pontiac Pietertje	59959	2	23187.0	3.305	766.33
	King of the Pontiacs 8th	63637	3	15558.7	3.647	567.43
	King Pontiac Portia	63895	2	21525.0	3.505	754.45
	King Pontiac Artis	63994	3	18239.3	3.547	646.95
	King Pontiac Shadeland	113938	2	17754.0	3.545	629.38
	Mean			20043.6	3.483	694.47
65	Greenwood Spofford Corona	36319				
	Major Spofford Corona	42729	2	20241.0	3.420	692.24
66	Albina Butter Boy	64755				
	Virginia Korndyke Butter Boy	128445	2	20087.0	3.440	690.99
67	Vale Aaltje Posch	34932				
	Vale Mercedes Posch	41416	5	18704.2	3.686	689.44
68	Katy Spofford Corona's Son	29521				
	Sir Ybma Spofford Pledge	39074	4	19029.0	3.623	689.42
69	Johanna Rue 3d's Lad	26939	5	23132.8	3.646	843.42
	Prince Johanna DeKol	31168	2	22390.0	3.450	772.46
	Sir Johanna DeKol Rue	33437	4	18585.8	3.595	668.16
	Sir Johanna Vernon DeKol	37409	2	19653.0	3.275	643.64
	Johanna Pontiac DeKol	41980	5	18403.4	3.630	668.04
	Mean			19758.1	3.488	688.08
70	Beryl Wayne's Son	30413	2	17805.0	3.235	575.99
	Pride of Maplehurst Roe	44085	2	19636.5	3.495	686.30
71	Sir Fayne Concordia	35227	8	20228.4	3.283	664.10
	Sir Johanna Fayne	42147	18	22279.6	3.150	701.81
	Sir Johanna Bonheur Fayne	45671	7	19672.9	3.447	678.12
	Colantha Johanna Champion	45674	4	26894.5	3.495	939.96
	Johanna Colantha 2d's Sir Fayne	45998	2	15523.0	3.205	497.51
	Johanna Bonheur Sir Fayne	46595	2	17617.5	3.250	572.57
	Sir Johanna Ruth Fayne	53055	2	25729.0	3.240	833.62
	Sir Johanna Colantha Concordia	53059	4	17635.8	3.273	577.22
	Mean			20764.6	3.294	685.83
72	Johanna Aaggie's Sarcastic Lad	26935				
	Beryl Wayne's Son	30413	2	17805.0	3.235	575.99
	Aaggie Cornucopia Johanna Lad	32554	3	21427.3	3.173	679.89
	Homestead Girl DeKol Sarcastic Lad	32558	17	23276.9	3.417	795.37
	Mean			20836.4	3.275	683.75
73	Sir Johanna Netherland Challenge	46090				
	Sir Challenge Diamond Beauty	57908	3	19218.0	3.557	683.58
74	Chief Piebe Oak Duchess	28176				
	Alcartra Polkadot Corrector	30624	13	20615.3	3.301	680.51

Performance of the Progeny of the Sons of Holstein-Friesian Sires for Milk Yield, Butter-Fat Percentage and Butter-Fat.—Continued

No.	Name of Sire and Sons	H.B. No.	No. of Daughters	Milk Yield	B.F. %	Butter-Fat
75	King Segis	36168				
	Johanna McKinley Segis	44367	2	25675.0	3.400	872.95
	King Segis Pontiac	44444	5	17512.0	3.444	603.11
	Pietertje Hengerveld Segis	44781	3	17310.0	3.770	652.59
	King Segis Pontiac Pietertje	48358	4	22477.8	3.460	777.73
	King Segis Beets	48702	3	27812.0	3.240	901.11
	Walker Korndyke Segis	50347	2	24731.5	3.545	876.73
	Sir Walker Segis	50672	12	18375.0	3.261	599.21
	Sir Prilly Segis	51510	3	18144.3	3.250	589.69
	Judge Beets Segis	51511	2	17189.0	3.405	584.98
	King Segis Hengerveld	51523	3	14662.3	3.397	498.08
	Gem Segis Beets	52297	2	15553.0	3.450	536.58
	Sir Winana Beets Segis	52927	6	18879.3	3.517	663.98
	King Segis Hengerveld Vale	60344	8	18803.5	3.524	662.64
	Mean			19778.1	3.436	678.41
76	Pontiac Hengerveld Parthenea	39972	7	17855.7	3.450	616.02
	Spring Brook Hengerveld Parthenea	68946	4	22897.3	2.960	677.76
77	Mechthildus Promise	27825				
	DeKol Spofford Promise	40207	3	18816.0	3.60	677.38
78	Sir Johanna Bonheur Fayne	45671	7	19672.9	3.447	678.12
	Sir Princess Johanna	57926	2	17767.5	3.810	676.94
79	Aaggie Cornucopia Pauline Count	29642				
	Cornucopia Waukasha Prince	35119	2	27030.5	3.715	1004.18
	Paul Cornucopia America	39994	2	14700.0	3.550	521.85
	Aaggie Cornucopia Pauline Count 13th	44293	10	19466.6	3.763	732.53
	Aaggie Cornucopia Pauline Count 7th	44758	3	18712.7	3.297	616.96
	Cornucopia Hengerveld DeKol	49221	3	17182.7	3.727	640.40
	Star Farm Inka Count	53247	2	16430.5	3.320	545.49
	Mean			18920.5	3.562	676.90
80	Sir Ormsby Hengerveld DeKol	31212	14	16533.3	3.516	581.31
	Sir Ormsby Johanna DeKol	37689	2	17113.0	3.289	561.31
	Prince Ormsby Mercedes DeKol	47008	3	19254.7	3.840	739.38
	Sir Ormsby Skylark	47010	3	24374.0	3.607	879.17
	King Ormsby	54424	3	19470.0	3.563	693.72
	King Pietertje Hengerveld Ormsby	107790	2	15376.0	3.310	508.95
	Mean			19117.5	3.520	676.51
81	Pontiac Cornucopia	38977	2	18516.5	3.215	595.31
	Pontiac Cornucopia Coronis	51148	2	22071.5	3.065	676.49
82	Paul Mechthilde DeKol	22233	4	16703.8	3.438	574.28
	Mechthilde DeKol Pietertje Paul	29548	2	20251.0	3.340	676.38
83	King Veeman DeKol	36819	3	17712.7	3.070	543.78
	Ladoga King Veeman DeKol	43496	3	20169.0	3.353	676.27
84	DeKol 2d's Butter Boy	21366				
	DeKol Burke	22991	8	19158.9	3.248	622.28
	Hengerveld DeKol	23102	5	19836.2	3.674	728.78
	Mean			19497.6	3.461	675.53
85	Butter Boy Pietertje	26533				
	Butter Boy Mercedes Prince	30139	2	17290.0	3.630	627.63
	Butter Boy Model DeKol	37222	2	14654.0	3.315	485.78
	Butter Boy Sir Mechthilde	37302	3	23080.7	3.037	719.18
	Linden Butter Boy Pietertje	54120	3	26824.0	3.230	866.42
	Mean			20612.2	3.303	674.75
86	Sir Aaltje Posch	31789	2	15557.5	3.020	469.84
	Sir Johanna Aaggie Posch	38401	7	18425.6	3.653	673.09
87	Aaltje Salo Mercedes DeKol Prince	39357	8	17642.3	3.445	607.78
	Prince Leo Aaltje	61435	3	18921.7	3.557	673.04
88	Friend Hengerveld DeKol Butter Boy	29303	5	25516.6	3.958	1009.95
	Maplecrest Butter Boy DeKol	94156	2	19328.0	3.480	672.61
89	DeKol 2d's Paul DeKol No. 4	23519				
	Inka Mechthilde Prince	29214	2	21695.0	3.100	672.55
90	Canary Mercedes Pietertje Hartog	44467				
	Canary Mercedes Pietertje Hartog 6th	78123	2	20725.0	3.245	672.53
91	Mooie Mutual DeKol	32846				
	Fayne Sir Mutual DeKol	38243	3	20439.3	3.143	642.41
	Mooie Fayne DeKol	38505	2	23423.5	3.490	817.48

Performance of the Progeny of the Sons of Holstein-Friesian Sires for Milk Yield, Butter-Fat Percentage and Butter-Fat.—Continued.

No.	Name of Sire and Sons	H.B. No.	No. of Daughters	Milk Yield	B.F. %	Butter-Fat
	Wisconsin Bess Mooie DeKol	40248	2	20275.0	3.505	710.64
	Fobes Tritomia Mutual DeKol	40534	6	18576.7	3.455	641.82
	Sir Mooie Oak DeKol	41220	3	19080.7	3.053	582.53
	Mutual Piebe DeKol	44554	8	19657.3	3.255	639.85
	Mean			20242.1	3.317	672.46
92	Homestead Hengerveld Crown DeKol	26345	3	21888.0	3.867	846.41
	Crown Pauline Sir Hengerveld	41038	2	17695.0	3.795	671.53
93	Gem Pietertje Paul DeKol	27282	2	22268.0	3.330	741.52
	Gem Pietertje Paul DeKol 3d	44658	7	18655.3	3.599	671.40
94	King Ormsby	54424	3	19470.0	3.563	693.72
	King Ormsby Parthenea	81630	5	19088.0	3.500	668.08
95	Korndyke Hengerveld Sir Paul DeKol	32635				
	Korndyke Hengerveld Gerben DeKol	50361	3	19130.3	3.490	667.65
96	Sir Cornelia Posch	36068				
	Tidy Abbekerk Prince	37770	5	19752.0	3.378	667.22
97	Gracia Ward Piebe	31361				
	Prince Homestead DeKol	34944	6	20007.3	3.332	666.64
98	Homestead Dieuwertje DeKol Paul	27157				
	Sir Forrisy DeKol Paul	40492	4	21052.8	3.165	666.32
99	Pietertje Hengerveld's Count DeKol	23224				
	Plum Hengerveld DeKol	27141	2	20515.0	3.120	640.07
	Aaggie Clothilde Bawn DeKol	33207	3	17903.0	3.120	558.57
	Count Pietertje Hengerveld DeKol	41757	2	23191.5	2.960	686.47
	Pietertje Hengerveld Mercena DeKol	42381	2	17637.0	3.110	548.51
	King of the Hengervelds	44465	2	22328.0	3.095	691.05
	Dutchland Sir Pietertje Hengerveld	48696	3	25020.0	3.487	872.45
	Mean			21099.1	3.149	666.19
100	Leda Inka Sir Gerben 2d	38287				
	Sir Gerben Pietertje	40214	2	19959.5	3.330	664.65
101	DeKol 2d's Paul DeKol	20735				
	Paul Mechthilde DeKol	22233	4	16703.8	3.438	574.28
	Paul Beets DeKol	22235	3	23408.0	3.307	774.10
	DeKol 2d's Paul DeKol No. 2	23366	2	18699.0	3.525	659.14
	DeKol 2d's Paul DeKol No. 5	25049	2	17945.0	3.625	650.51
	Mean			19189.0	3.474	664.51
102	Sarcastic Lad	23971	10	15256.3	3.241	494.46
	Sir Johanna Friend Clothilde	26937	3	20328.3	3.087	627.53
	Johanna DeKol's Lad	26938	20	18423.8	3.275	603.38
	Johanna Rue 3d's Lad	26939	5	23132.8	3.646	843.42
	Colantha 4th's Lad	26940	6	18265.8	3.478	635.28
	Johanna Colantha's Lad	28296	4	22431.5	3.270	733.51
	Johanna de Pauline 2d's Lad	28301	4	23329.8	3.343	779.92
	Colantha Johanna Lad	32481	8	24732.1	3.326	822.59
	Johanna Rue Lad	34989	2	19012.5	2.980	566.57
	Johanna Rue Sarcastic Lad	34990	4	19235.3	3.503	673.81
	Johanna Colantha Sarcastic Lad	38402	9	22501.3	3.177	714.87
	Sunny Jim	38883	2	15560.5	3.340	519.72
	Parthenea Sarcastic	42448	4	18117.5	3.280	594.25
	Leland Sarcastic	42451	2	17391.0	3.010	523.47
	Mean			20189.4	3.286	664.49
103	DeKol Hengerveld Burke	29737	2	16755.0	3.790	635.01
	Sir Urmagel Burke	58219	5	19734.6	3.360	663.08
104	Pontiac Pauline Paul	24851				
	Sir Pontiac Beets Korndyke	37200	2	17679.0	3.750	662.96
105	Cornelia Dandy of Riverside	42644				
	Cornelia King	86166	3	17863.7	3.710	662.74
106	Belle Korndyke Butter Boy	27856				
	Prex Korndyke DeKol	35900	2	18025.0	3.665	660.62
107	Sir Johanna DeKol	25467	14	18932.1	3.364	636.88
	Sir Johanna Rue DeKol	31387	2	17496.5	3.785	662.24
	Sir Johanna DeKol 19th	64143	4	20017.5	3.270	654.57
	Mean			18757.0	3.528	658.41
108	Paul Beets DeKol	22235	3	23408.0	3.307	774.10
	Oakland Paul Beets Burke	53309	2	19431.5	3.380	656.78

Performance of the Progeny of the Sons of Holstein-Friesian Sires for Milk Yield, Butter-Fat Percentage and Butter-Fat.—Continued.

No.	Name of Sire and Sons	H.B. No.	No. of Daughters	Milk Yield	B.F. %	Butter-Fat
109	Hengerveld DeKol	23102	5	19836.2	3.674	728.78
	Pontiac Cronus	28835	4	21336.0	3.133	668.46
	Pontiac Hengerveld DeKol	29027	5	18083.8	3.284	593.87
	Pontiac Zephyrus	39426	4	17502.5	3.688	645.49
	Pontiac Hengerveld Parthenea	39972	7	17855.7	3.450	616.02
	Sir Hengerveld Model Johanna	40338	10	21945.9	3.339	732.77
	Sir Korndyke Hengerveld DeKol	41266	11	18180.4	3.606	655.59
	Pontiac Arcas	41484	2	14738.5	3.355	494.48
	Judge Hengerveld DeKol	43964	2	23063.0	3.780	871.78
	Hengerveld Butter Boy DeKol	44543	3	15728.3	3.353	527.37
	Woodcrest Hengerveld DeKol	46514	2	21668.0	3.395	735.63
	Gordon Glen Hengerveld DeKol	52410	3	20871.7	3.217	671.44
	Mean			19179.4	3.418	655.72
110	Sadie Vale Concordia's Paul DeKol	27392				
	Sadie Vale Concordia's Paul DeKol 3d	33661	2	20453.5	3.160	646.33
	Tirania Lady Colantha Hero	35250	2	20082.0	3.310	664.71
	Mean			20267.8	3.235	655.52
111	Pontiac Butter Boy	23154				
	DeKol Creamelle Pontiac Butter Boy	48498	4	20406.5	3.208	654.64
112	Lyons Hengerveld Count DeKol	40592				
	Parkside Spofford Lyons DeKol	58022	2	16189.0	3.595	567.42
	Greenwood Johanna Lyons	62049	2	19131.0	3.875	741.33
	Mean			17660.0	3.690	654.38
113	Mazeppa	2941 F.H.B.				
	Woodcrest Pietje	35469	2	18692.0	3.500	654.22
114	Aaggie Cornucopia Johanna Lad	32554	3	21427.3	3.173	679.89
	Aaggie Cornucopia Johanna Lad Jr.	36974	9	23454.7	3.017	707.63
	Sir Beets Cornucopia Netherland	38460	4	17400.8	3.065	533.33
	Pontiac Cornucopia	38977	2	18516.5	3.215	595.31
	The Milk & Butter King	41114	2	25302.5	3.105	785.64
	Sir Cornucopia Prince	48663	6	19428.7	3.262	633.76
	Mean			20820.6	3.133	651.13
115	Calamity Jane's Paul A.	26250				
	Canary Mercedes Paul	29600	6	17799.7	3.657	650.94
116	Riverside Tommy	46136				
	Sir Colantha Juliana	67203	2	15045.0	3.730	561.18
	Aralia King	86837	5	20004.8	3.680	737.77
	Mean			17524.9	3.705	649.48
117	Paul Johanna DeKol	21318				
	Pearl of the Dairy's Joe DeKol	23450	9	17890.7	3.630	649.43
118	Sir Johanna DeKol 12th	43305				
	Sir Johanna Genevra	53399	2	20104.0	3.225	648.35
119	Pontiac Rhadamanthus	41481				
	Christmas Pontiac King	52983	3	19709.0	3.280	646.46
120	Sir Hengerveld Model Johanna	40338	10	21945.9	3.339	732.77
	Norwood Veeman Hengerveld DeKol	65016	2	17440.5	3.705	646.17
121	Wartenea Netherland Prince	22326				
	Duchess Ormsby Prince	25796	2	15096.0	4.270	644.60
122	Vale DeKol Clothilde	31030				
	Hillside Vale	41751	5	17773.8	3.624	644.12
123	Hazelwood Ormsby Posch	59042				
	Hazelwood Sir Ormsby	77572	2	20236.5	3.180	643.52
124	Hengerveld Soldene DeKol	57729				
	Hengerveld Soldene Washington	107891	3	19319.7	3.310	639.48
125	Jewel Paul	29463	2	21824.0	3.560	776.93
	Jewel Paul 13th	58769	3	18263.0	3.500	639.21
126	Sir Mechthilde Jewel	32732				
	Sir Jewel Parthenea Doede	38639	3	19798.3	3.730	738.48
	Paul Jewel DeKol Mechthilde	44916	2	14554.0	3.705	539.22
	Mean			17176.2	3.718	638.85
127	Lord Netherland Cornucopia DeKol	37599				
	Redbud Cornucopia DeKol King	93229	5	18765.6	3.404	638.78
128	Oakland Cayuga Chief	27100				
	Romeo Aaggie Acme of Riverside	32422	6	18198.8	3.510	638.78

Performance of the Progeny of the Sons of Holstein-Friesian Sires for Milk Yield, Butter-Fat Percentage and Butter-Fat.—Continued.

No.	Name of Sire and Sons	H.B. No.	No. of Daughters	Milk Yield	B.F. %	Butter-Fat
129	Lilith Pauline DeKol's Son	30412				
	Aaggie Cornucopia 3d's Lilith	34467	5	19631.2	3.482	683.56
	Tehee Lilith Pauline DeKol	36636	2	25064.0	2.950	739.39
	Sir Lilith Pauline Johanna	52527	2	14955.0	3.295	492.77
	Mean			19883.4	3.242	638.57
130	Virgo Beauty Duke	24528				
	Alma Prince Jewel	32731	3	19878.3	3.207	637.50
131	Legend of Sleepy Hollow	28300				
	Brom Bones	35903	4	18027.5	3.535	637.27
132	Koningen Gloster	23377				
	Duke Koningen	24819	2	17080.5	3.730	637.10
133	Korndyke Prince Grace DeKol	32655	2	15473.0	3.370	521.44
	Minnie Hark Prince Korndyke	41660	2	18492.0	3.445	637.05
134	Sir Beets Cornucopia Netherland	38460	4	17400.8	3.065	533.33
	North Star Longfield Sir Beets	97403	2	19097.0	3.335	636.88
135	Sir Johanna	23446				
	Sir Johanna DeKol	25467	14	18932.1	3.364	636.88
136	Prince Ybma Spofford	34709				
	Prince Ybma Spofford 6th	47135	3	17601.3	3.610	635.41
137	Beryl Wayne's Paul DeKol	26766				
	Beryl Wayne Korndyke of Riverside	32322	5	18755.6	3.442	645.57
	Belle Korndyke Beryl Wayne	32386	2	19065.0	3.530	672.99
	Beryl Wayne Veeman	35431	3	13698.3	3.550	486.29
	Prince Pietertje Beryl	46977	3	21649.7	3.383	732.41
	Mean			18292.2	3.476	634.32
138	Judge Akkrum Lilly DeKol	91667				
	Riverview Hengerveld	93371	2	22403.5	2.820	631.78
139	Hengerveld Artis Hero	24967				
	Gerster 7th's Hero	35165	4	19525.0	3.230	630.66
140	Sir Piebe DeKol	26239				
	Minnie Sandes 2d's Sir Piebe DeKol	29500	4	18731.5	3.360	629.38
141	Pietje 22d's Woodcrest Lad	39849	2	18309.5	3.560	651.82
	Woodcrest Pietje Ormsby	54909	2	15244.5	3.670	559.47
	Pietje Burke	58313	4	20316.5	3.438	698.48
	Mean			17780.5	3.554	628.98
142	Margolyn 2d's Clyde DeKol	30101				
	Nieta Pauline Duke	40386	2	20934.0	3.00	628.02
143	DeKol 2d's Paul DeKol No. 2	23366	2	18699.0	3.525	659.14
	Sir Daisy Mercedes DeKol (Twin)	28982	2	20587.0	3.645	750.40
	May Paul DeKol	31957	2	15693.5	3.215	504.55
	Mean			18140.3	3.430	627.48
144	Rag Apple Korndyke	48020				
	Rag Apple Korndyke DeKol	67211	4	15772.0	3.583	565.11
	Rag Apple Korndyke 8th	73416	3	19978.0	3.447	688.64
	Mean			17875.0	3.515	626.88
145	Gem Pietertje Hengerveld Paul DeKol	23300				
	Gem Pietertje Paul DeKol	27282	2	22268.0	3.330	741.52
	Wit Duchess Gem	31208	2	16483.5	3.415	562.91
	Sir Hengerveld DeKol Ormsby (Twin)	31211	4	16966.5	3.623	614.70
	Sir Ormsby Hengerveld DeKol	31212	14	16533.3	3.516	581.31
	Mean			18062.8	3.471	625.11
146	Hengerveld DeKol 5th	54721				
	Hengerveld Homestead DeKol	93149	2	17221.0	3.625	624.26
147	Prince Beauty Pietertje Hartog	45074	3	18978.0	3.333	632.54
	Madge Prince Hartog	56632	2	21438.5	2.905	622.79
148	Paul DeKol Jr.	24762				
	Homestead Jr. DeKol	28400	3	17779.0	3.393	603.24
	Junior DeKol (Twin)	30830	2	19861.5	3.205	636.56
	Paul Piebe DeKol	32059	3	20151.0	3.373	679.69
	Luecke Paul	33289	2	16072.0	3.540	568.95
	Mean			18465.9	3.378	622.11
149	Sir Skylark Johanna	33242				
	Kalmuck Skylark Johanna	48832	4	15647.8	3.973	621.69
150	Paul Clyde	27041				
	Johanna Clothilde 3d's Clyde	30550	7	17284.7	3.300	570.40
	Johanna Sarcastic Paul	30551	2	22475.0	3.115	700.10
	Sir Musser Clyde DeKol	40368	2	16244.5	3.630	589.68
	Mean			18668.1	3.348	620.06

Performance of the Progeny of the Sons of Holstein-Friesian Sires for Milk Yield, Butter-Fat Percentage and Butter-Fat.—Continued.

No.	Name of Sire and Sons	H.B. No.	No. of Daughters	Milk Yield	B.F. %	Butter-Fat
151	Easle Groton 3d's Johanna DeKol	27784				
	Count Aaggie Netherland DeKol	35887	3	17502.3	3.540	619.58
152	Junior DeKol	30830	2	19861.5	3.205	636.56
	Junior Concordia DeKol	35975	2	17328.5	3.565	617.76
153	Johanna Rue 2d's Paul DeKol	21724	5	13842.8	3.152	436.33
	St. Paul DeKol	31338	3	18948.7	3.307	626.63
	Tina Clay Johanna	38214	6	18390.5	3.307	608.17
	Mean			18669.6	3.307	617.40
154	DeKol 2d's Paul DeKol Prince	23520				
	Prince Leila DeKol	29358	3	18192.0	3.390	616.71
155	Korndyke Queen DeKol's Prince	26025	9	20915.0	3.399	710.90
	Segis DeKol Korndyke Prince	31846	2	17663.0	3.535	624.39
	Small Hopes Korndyke DeKol	32260	2	15311.5	3.430	525.18
	Korndyke Prince Grace DeKol	32655	2	15473.0	3.370	521.44
	Lorena Korndyke	81497	2	19939.0	3.385	674.94
	Prince Alcartra Korndyke	88318	5	20989.6	3.504	735.48
	Mean			17875.2	3.445	616.29
156	Sir Piebe Hengerveld DeKol	27929				
	Sir Piebe DeKol Ringwood	31215	2	18424.5	3.475	640.25
	Sir Piebe Aaggie Hengerveld	32492	10	19229.8	3.599	692.08
	Canary Piebe DeKol	35188	2	15764.5	3.345	527.32
	Sir Piebe Johanna Sarcastic	37094	4	18808.0	3.215	604.68
	Mean			18056.7	3.409	616.08
157	Aaggie Cornucopia Johanna Lad Jr.	36974	9	23454.7	3.047	707.63
	Cornucopia Monarch Vale	59156	2	21970.0	3.005	660.20
	Aaggie Cornucopia Johanna Lad Jr. 5th	60529	4	19346.5	3.250	628.76
	DeKol Paul Cornucopia King	71071	2	16404.0	3.385	555.28
	Mean			19240.2	3.213	614.75
158	Sir William Clothlide	23782				
	Sir William Prince	37226	3	19440.0	3.160	614.30
159	Duchess Ormsby Piebe Burke	29328	4	15023.3	3.830	575.39
	Jessie Fobes Tritomia Duke	32254	5	17653.0	3.394	599.14
	King Oak Grove	42235	4	17152.3	3.663	628.29
	Mean			17402.7	3.529	613.72
160	Cybele's Pietertje Chief	21238				
	Agatha Netherland Pietertje	26980	2	18041.5	3.400	613.41
161	Alta Posch's Son	30154				
	Sir Homestead Posch DeKol	37314	9	16618.1	3.396	564.35
	Sir Lilith Posch	42682	3	17965.7	3.593	645.51
	Yakima Cornucopia	36220	3	19475.0	3.233	629.63
	Mean			18019.6	3.407	613.16
162	Piebe Paul	31954				
	Knight Errant	39566	3	17517.3	3.497	612.58
163	Sir Gem DeKol	29330				
	Sir Mercedes DeKol Pet	34205	2	18123.5	3.370	610.76
164	Chief Josephine Mechthilde	26483				
	Sir Josephine Mechthilde Pietertje	32110	2	16448.5	3.695	607.77
165	Piebe DeKol Burke	25368				
	Sir Ormsby DeKol	27284	2	15916.5	3.570	568.22
	Duchess Ormsby Piebe Burke	29328	4	15023.3	3.830	575.39
	Duchess Ormsby Butter King	30190	3	19483.3	3.487	679.38
	Mean			16807.7	3.629	607.66
166	King of the Hengervelds	44465	2	22328.0	3.095	691.05
	King Soldene Butterfly	91668	2	18781.5	3.235	607.58
167	Beauty Pietertje Butter King	38462				
	Prince Pietertje Maid	42033	7	17504.1	3.246	568.18
	Prince Beauty Pietertje Hartog	45074	3	18978.0	3.333	632.54
	King Prilly Pietertje	46212	2	15196.0	3.205	487.03
	Beauty Pietertje Prince	56435	4	21480.3	3.448	740.65
	Mean			18289.6	3.308	607.10
168	A & G Butter King	25729				
	King Koningen DeKol	29813	2	17287.5	3.510	606.79
169	Pledge Spofford Calamity Paul	44726				
	Dichter Calamity Segis DeKol	59219	2	20276.0	2.990	606.25

Performance of the Progeny of the Sons of Holstein-Friesian Sires for Milk Yield, Butter-Fat Percentage and Butter-Fat.—Continued.

No.	Name of Sire and Sons	H.B. No.	No. of Daughters	Milk Yield	B.F. %	Butter-Fat
170	Pietertje Hengerveld's Paul DeKol	22128				
	Homestead Crown Prince DeKol	25865	4	14481.3	3.948	571.72
	Canary Paul	48528	6	17296.5	3.703	640.49
	Mean			15888.9	3.826	606.11
171	King Pontiac Champion	53418	20	22620.3	3.512	794.42
	King Champion Victoria	68544	5	16060.0	3.660	587.80
	Pabst Pontiac Champion	105106	2	19803.5	3.125	618.84
	Mean			17931.5	3.393	603.32
172	Homestead Jr. DeKol	28400	3	17779.0	3.393	603.24
	Sunnyside Homestead DeKol	35226	3	14811.3	3.447	510.55
	Sir Fayne Concordia	35227	8	20228.4	3.283	664.10
	Fobes DeKol Homestead	55736	2	17489.0	3.290	575.39
	Duke Fobes	60047	5	16923.2	3.382	572.34
	Emblagaard Tritomia Homestead	62924	12	20774.7	3.329	691.59
	Mean			18045.3	3.346	602.79
173	Second Sir Josephine Mechthilde	24478				
	Beechwood Sir Josephine	26734	2	19505.0	3.090	602.70
174	Sir Colantha Juliana	67203	2	15045.0	3.730	561.18
	Sir Colantha Juliana 2d	98762	2	17174.5	3.500	601.11
175	DeKol Pietertje Prince	23223				
	DeKol Pietertje Prince 2d	27930	2	16414.5	3.660	600.77
176	DeKol Burke	22991	8	19158.9	3.248	622.28
	Almeda Luecke 2d's Son	30266	2	19695.5	3.050	600.71
177	Kate Spray 3d Johanna	56688				
	Downing Johanna Burke DeKol	84472	2	16796.0	3.545	595.42
178	Leland Sarcastic	42451	2	17391.0	3.010	523.47
	Missouri Chief Josephine Lad	70857	4	20504.8	2.903	595.25
179	Prince Johanna DeKol	31168	2	22390.0	3.450	772.46
	Sir Johanna DeKol Darkness	40871	2	17119.0	3.460	592.32
180	Sir Pontiac Korndyke	39041				
	Sir Pontiac Korndyke Pietertje	53618	2	19236.0	3.075	591.51
181	Homestead Girl DeKol Sarcastic Lad	32558	17	23276.9	3.417	795.37
	Johan Uilkje Lad	37852	2	17931.5	3.630	650.91
	Pietje 22d's Wooderest Lad	39849	2	18309.5	3.560	651.82
	Wooderest DeKol Burke	40718	2	16846.5	3.125	526.45
	Wooderest DeKol Lad	45103	4	14123.8	3.708	523.71
	Star Farm Johanna Lad	45224	11	16731.8	3.520	588.96
	Pietje 22d Son	58314	2	16748.5	3.540	592.90
	Plum Lad	59272	2	14559.0	3.270	476.08
	Johan Wooderest Lad	52145	5	17864.4	3.500	625.25
	Wooderest Tehee	74219	13	20938.4	3.283	687.41
	Mean			17117.0	3.460	591.50
182	Fobes Tritomia Mutual DeKol	40534	6	18576.7	3.455	641.82
	Jessie Fobes Mutual	55732	5	17582.6	3.282	577.06
	Oak DeKol 2d Homestead Fobes	65750	3	19252.0	3.140	604.51
	Mean			18417.3	3.211	590.79
183	Manor DeKol	21226				
	DeKol 2d's Butter Boy 3d	23269	8	21501.6	3.535	760.08
	Manor DeKol's Plum	24777	2	13006.0	3.240	421.39
	Mean			17253.8	3.388	590.74
184	Sir Abbekerk Posch	28629				
	Ianthe Sir Posch	33957	2	17770.5	3.320	589.98
185	Paul Beets Walker	44478				
	Rollingdale Pauline Beets	76861	2	15732.5	3.740	588.40
186	Sir Johanna DeKol 19th	64143	4	20017.5	3.270	654.57
	Cedar Lawn Sir Johanna	104002	3	19871.3	2.957	587.59
187	Meibloem 3d's Maseppa	34914				
	Meibloem DeKol	46593	3	15720.7	3.727	585.91
188	Lord Bonheur	39810				
	Hollins Harlem	49795	2	18077.0	3.240	585.69
189	Paul Cornucopia Mercedes DeKol 3d	68804				
	Paul Cornucopia Mercedes Aaggie	94884	6	15619.3	3.737	583.69
190	Hengerveld DeKol 3d	46475				
	Hengerveld DeKol Tromp	81405	3	18669.7	3.123	583.05
191	Mooie Oak DeKol	40536				
	Mooie Oak DeKol 2d	60278	2	16752.5	3.480	582.99

Performance of the Progeny of the Sons of Holstein-Friesian Sires for Milk Yield, Butter-Fat Percentage and Butter-Fat.—Continued.

No.	Name of Sire and Sons	H.B. No.	No. of Daughters	Milk Yield	B.F. %	Butter-Fat
192	Carlotta 2d's Sir Parthenea	454 W. H.F.A.	2	17569.0	3.315	582.41
193	Sir Johanna Aaggie Fayne	42141				
	Johanna Fayne Hartog	65981	2	18292.0	3.175	580.77
194	Judge Beets Segis	51511	2	17180.0	3.405	584.98
	Segis Longfield Homestead	75627	2	19606.0	2.955	579.36
195	Colantha 4th's Lad	26940	6	18265.8	3.478	635.28
	Beppo Jewel Lad	30634	3	16485.0	3.457	569.89
	Lad of Home Farm	33642	2	18896.5	3.565	673.66
	Iowana Lad	70753	3	14805.0	3.337	494.04
	Mean			16728.8	3.453	579.20
196	Sir Korndyke Hengerveld DeKol	41266	11	18189.4	3.606	655.59
	Sir Korndyke Hengerveld Canary	53825	6	13816.8	3.308	457.06
	Sir Korndyke Hengerveld DeKol 36th	85968	3	20235.7	3.453	698.74
	Mean			17026.3	3.381	577.90
197	Homestead Longfield DeKol	49533				
	Piebe Longfield DeKol	51217	4	17680.3	3.258	576.02
198	Pietertje Hengerveld Segis	44781	3	17310.0	3.770	652.59
	Elmwood Sir Hengerveld Segis	71527	2	16783.5	3.430	575.67
	Arcady Segis Hengerveld Wayne	75304	4	19040.8	3.023	575.60
	Mean			17912.2	3.227	575.64
199	Jessie Fobes Tritomia Duke	32254	5	17653.0	3.394	599.14
	Gudultje Gerben Sir Fobes	42183	4	17115.3	3.360	575.07
200	Paul DeKol	14634				
	Paul DeKol 3d	22894	2	21026.0	3.255	684.40
	Anual's Paul DeKol	26167	2	14283.5	3.245	463.50
	Mean			17654.8	3.250	573.95
201	Prince Inka Pietertje DeKol	21089				
	Prince Inka Pietertje DeKol 2d	22699	3	16468.0	3.470	571.44
202	Buckeye Duke Spencer	40776				
	Duke Spencer Lyons	45652	2	18749.0	3.010	564.34
203	DeKol 2d's Paul DeKol No. 1	23518				
	Pietertje DeKol Paul DeKol	41895	2	15861.0	3.555	563.86
204	Mutual Pietertje Paul	31943				
	Paul Frenesta DeKol	41206	20	17668.8	3.189	563.46
205	Clothilde Monk's Count 2d	30328				
	Sir Henry Netherland of Hollins	30674	6	17268.0	3.263	563.45
206	Vale Barber DeKol	36241				
	Captain Pietertje Barber	41009	2	16753.5	3.335	558.73
207	Pontiac Hesseltje DeKol	35607				
	Sir Pontiac DeKol Burke	50920	2	15192.0	3.675	558.31
208	DeKol Creamelle Pontiac Butter Boy	48498	4	20406.5	3.208	654.64
	Creamelle Aaggie Taurus	80551	2	18432.0	3.020	556.65
209	Sir Henry Gerben	25190				
	Gerben Boelyn	28243	2	16727.0	3.310	553.66
210	Pontiac Hesseltje Korndyke	31438	5	19562.6	3.508	686.26
	Dutchland Sir Korndyke Gladi	48121	2	15828.0	3.490	552.40
211	Tulip Inka DeKol Hengerveld	34356				
	Tulip Hengerveld DeKol	41562	3	16536.0	3.330	550.65
212	Pontiac Burke	33979	2	24954.0	3.280	818.49
	Pontiac Carlotta Gerben	45807	4	15095.5	3.640	549.48
213	Ethel Alexander's Sir DeKol	27022				
	Samuel DeKol	36903	2	15764.5	3.470	547.03
214	Homestead Masterpiece	49643				
	Homestead Masterpiece Aaggie	59682	6	16705.0	3.258	544.25
215	Sir Korndyke Manor DeKol	28133				
	Sir Korndyke Pontiac Artis	46301	5	15411.2	3.524	543.09
216	Homestead Vernon DeKol	23969				
	Sir Von Harlingen Vernon DeKol	29876	2	16498.0	3.275	540.31
217	Oatka Chief	18410				
	Clothilde Chief	20994	2	15889.0	3.400	540.23
218	Ida Lyons 2d Korndyke	51518				

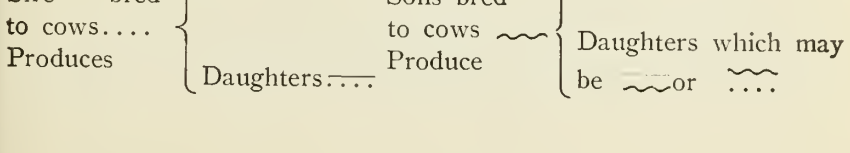
Performance of the Progeny of the Sons of Holstein-Friesian Sires for Milk Yield, Butter-Fat Percentage and Butter-Fat.—Concluded.

No.	Name of Sire and Sons	H.B. No.	No. of Daughters	Milk Yield	B.F. %	Butter-Fat
	Lakeside Model Alban	71013	2	16938.0	3.180	538.63
219	Aaggie Clothilde Bawn DeKol	33207	3	17903.0	3.120	558.57
	Joe Pride Aaggie DeKol	66417	2	17240.0	3.120	537.89
220	Sir Ida DeKol	42790				
	Sir DeKol Ruth	47341	2	16897.0	3.180	537.32
221	Aaggie Sir Ormsby	37203				
	Aaggie Sir Ormsby 2d	54001	2	15836.5	3.390	536.86
222	King Palmyra Fayne	72099	2	27034.0	3.220	870.49
	Hollywood Rocelia Palmyra	121546	2	16071.0	3.335	535.97
223	Beryl Wayne DeKol Paul	28785				
	Beryl Wayne DeKol Paul Pietertje	40663	2	16717.5	3.190	533.29
224	Netherland DeKol's Sir Mechthilde	22241				
	Sir Aaggie DeKol Netherland	29588	6	16185.0	3.282	531.19
225	Beets Ormsby	34502				
	Sir Beets DeKol Ormsby	46763	2	17108.0	3.085	527.78
226	DeKol 2d's Mutual Paul	25790	2	22650.5	3.270	740.67
	Sir Jolie DeKol	28633	2	16915.5	3.350	566.67
	Lord Nudine DeKol	35639	3	14199.0	2.970	421.71
	Mutual Paul Pietertje DeKol	35911	2	19822.0	2.990	592.63
	Mean			16978.8	3.103	527.02
227	Mutual Friend 3d's Pauline's Paul	27823				
	Mutual Friend DeKol Albrice	38079	5	16805.6	3.134	526.65
228	Korndyke Abbekerk	34503	4	21555.3	3.320	715.64
	Korndyke Abbekerk 3d	49288	6	14514.8	3.628	526.60
229	Hubbard Netherland DeKol	35221				
	Sir Hubbard Pietertje	48557	2	16919.5	3.100	524.50
230	Zanca DeKol's Count	27053				
	Dan Patch Hark	37807	2	14138.5	3.670	518.88
231	Guy Mercedes	10678				
	Jettine's Echo's Mercedes Prince	22499	2	15647.0	3.295	515.57
232	Minnie Hark Prince Korndyke	41660	2	18492.0	3.445	637.05
	Minnie Hark Pietertje Burke	57476	3	13862.3	3.717	515.26
233	Homestead Ormsby Duke	35256				
	Iowa Ormsby Duke	66092	2	16940.5	3.040	514.99
234	Prince Segis Korndyke Jr.	74094				
	Prince Segis Johanna Korndyke	97224	2	15542.0	3.290	511.33
235	King Segis Hengerveld	51523	3	14662.3	3.397	498.08
	Segis Hengerveld Johanna	76663	3	15642.3	3.387	529.80
	Sir Aaggie Cornucopia Segis	76665	2	14062.0	3.490	490.76
	Mean			14852.2	3.439	510.28
236	Pontiac Cronus	28835	4	21336.0	3.133	668.46
	Sir Carlotta Pontiac	38652	3	15501.7	3.097	480.09
	Sir Carlotta Pontiac Cronus	45502	4	15064.0	3.545	534.02
	Mean			15282.9	3.321	507.06
237	Johanna DeKol's Lad	26938	20	18423.8	3.275	603.38
	Johanna DeKol's Lad 2d	60360	2	14866.5	3.400	505.46
238	DeKol 2d's Butter Boy 2d	22989				
	Butter Boy Hengerveld DeKol	24937	3	15520.7	3.247	503.96
239	Count Pauline Paul DeKol	27829				
	Lord Indi DeKol	29882	2	15753.5	3.195	503.32
240	Peter DeKol Spofford	31996				
	Clear View Jimmy Koningen	51067	2	13816.5	3.635	502.22
241	Maurice Bonheur	22394				
	Sarcastic Lad	23971	10	15256.3	3.241	494.46
242	The Milk & Butter King	41114	2	25302.5	3.105	785.64
	The Milk & Butter King 2d	48846	2	14362.0	3.420	491.18
243	King Segis of Oak Knoll	49319				
	Piersma Albina Segis Lad	75361	5	14528.6	3.372	489.90
244	Sadie Vale Concordia's Paul DeKol 3d	33661	2	20453.5	3.160	646.33
	Sir Vale Daisy DeKol Paul	40547	2	16037.5	3.050	489.14
245	Sir Cornucopia Prince	48663	6	19428.7	3.262	633.76
	Sir College Cornucopia	59755	2	15659.0	3.120	488.56
246	Prince Segis Korndyke	38835				
	Duke Segis Inka Korndyke	49722	7	14773.7	3.304	488.12
247	Wayne Friend DeKol	30224				
	Manor DeKol Wayne	33894	4	14368.5	3.383	486.09

Performance of the Progeny of the Sons of Holstein-Friesian Sires for Milk Yield, Butter-Fat Percentage and Butter-Fat.—Concluded.

No.	Name of Sire and Sons	H.B. No.	No. of Daughters	Milk Yield	B.F. %	Butter-Fat
248	Count Hengerveld Johanna Fayne	68591				
	Woodcrest Gordon Fayne	97208	4	14702.5	3.300	485.18
249	Hartog Pauline DeKol Count	28433				
	Hartog Paul Burke	49910	3	13680.0	3.537	483.86
250	DeKol's Pietertje	21033				
	Earl Korndyke DeKol	24954	7	13722.0	3.519	482.88
251	Knight Errant	39566	3	17517.3	3.497	612.58
	Oak Grove Errant	47808	2	15317.0	3.120	477.89
252	Governor Walker	40591				
	Sir Segis Mutual Walker	80916	4	13261.3	3.590	476.08
253	Sir Johanna Canary DeKol	44034	3	22275.0	3.687	821.28
	North Star Johanna DeKol Duke	52163	2	14749.5	3.205	472.72
254	Pontiac Arcas	41484	2	14738.5	3.355	494.48
	Hollins Hamilton	55819	2	14350.0	3.290	472.12
255	Worthemall Sir Pietertje	28864				
	Sir Aaltje Posch	31789	2	15557.5	3.020	469.84
256	Paul Calamo Korndyke	49342				
	Paul Calamo Korndyke 3d	60710	2	14806.5	3.165	468.63
257	Parthenea's Sir Henry	8132				
	Parthenea's Sir Henry 2d	24091	2	13191.5	3.525	465.00
258	Inka Jupiter	34052				
	Inka Jupiter Jr.	43113	2	15500.5	2.990	463.46
259	Johanna Abbekerk Lad	35975				
	Sir Drosky Abbekerk	43075	3	12309.0	3.730	459.13
260	King Lyons Spofford	62053				
	King Lyons Spofford 3d	75034	2	13119.5	3.480	456.56
261	Pauline Paul's DeKol	21490				
	Gilbert Pauline Paul DeKol	27796	2	13489.0	3.305	445.81
262	Paul Mutual DeKol	18726				
	Johanna Rue 2d's Paul DeKol	21724	5	13842.8	3.152	436.33
263	Netherland Portage Paul DeKol	27552				
	Houwtje Portage Paul DeKol	39156	2	13836.0	3.135	433.76

In considering table 23 it is well to remember certain facts concerning the inheritance given by a bull to his sons' daughters as compared with the inheritance given by a bull to his own daughters. This can be brought out clearly by a diagram. Consider a sire's inheritance represented by a bar line————. Consider the inheritance of the cows to which he is bred, represented by dots..... Likewise, consider the inheritance of the cows to which the son is bred, represented by a wavy line ~~~ , we then have the diagram shown below.



From this diagram it is noted that the sire whose only record is the average of his daughters' records is only in truth half tested for his daughters have an equal inheritance from their dams which is not taken into consideration. Thus, a sire might have high producing or testing daughters and still not be a worthy sire due to the dam and not the sire giving to these daughters an inheritance for high milk yield or butter-fat per cent. This difficulty does not, of course, entirely invalidate the worth of the performance test of his daughters as a measure of a sire's worth. It does make it desirable to have besides this test another, which, this Station originated and applied to Jersey and Guernsey breeds known as the "Daughter Dam Test" of the sires' transmitting qualities. These data will follow in a succeeding paper.

Proceeding to the consideration of the inheritance given by a sire's sons to their daughters we find from the above diagram that the daughters of such sons may not receive any inheritance whatsoever from their grandsires. Such cases will, of course, be rare. On the average such daughters will receive about one-fourth of their inheritance from their grandsire. This one-fourth inheritance received by the son's daughters when compared with the one-half inheritance received by the own daughters of the sire makes it clear that the test of a sire's worth through the performance of his sons' daughters is much less reliable than is the test of his worth by the performance of his own daughters. For the progress of our dairy industry both kinds of information are needed. A careful balancing of the above considerations should be made in determining the worth of the sire.

Table 23 shows that the sons of King Fayne Segis sired daughters with a higher average yearly butter-fat production than any other bull. King Fayne Segis did not have any daughters with year records. His three sons, King Hengerveld Aaggie Fayne, King Palmyra Fayne and Masterpiece had an average butter-fat production of 1029.85 pounds for their daughters. The average milk yield was 27207.7 pounds for these bulls' daughters. The butter-fat percentage was 3.771 per cent.

Of the first 20 sires in table 23, 17 have only one son with a progeny performance test, 2 have two sons and 1 has 3 sons. Of the next twenty, 15 have only one son, 4 have two sons, and

one has 10 sons. For the third twenty sires 12 have but one son, 3 have two sons, 1 has three sons, 2 have four sons, 1 has five sons and 1 has six sons. From this, it may be concluded that the bull with several sons has a slightly less chance to be the sire of sons whose daughters' average butter-fat production is very high than has the bull with only one son. This phase of the subject carries considerable significance from another point of view. Bulls are often sold for high prices on the basis of what their brothers or sisters may have done to transmit or to give milk. An imaginary case may be cited. It has been shown in a previous part of this paper that King Segis Pontiac Count was a very excellent bull as measured by what his tested progeny did as milk producers. Suppose that some of his brothers are to be exhibited for sale undoubtedly, King Segis Pontiac Count's record would play an important part in the price. The inquiry may be made as to how much less than the record of King Pontiac Count may his brother's daughters' production be. King Segis Pontiac, sire number 41, gives the answer to this question. King Segis Pontiac Count has 10 daughters with an average butter-fat production of 975.82 pounds. A brother, King Pontiac Dione has 11 daughters with an average butter-fat production of 528.13 pounds or 447.69 pounds less than his brother. This case alone, and a number of others could be cited, shows that the transcendent merits of one animal should not be too heavily stressed in determining the probable worth of his immediate relatives.

A similar case can be made out for the record of the sires' daughters as a measure of the probable record of the sires' sons. Thus Sir Korndyke Hengerveld DeKol 36th's daughters produced on an average 698.74 pounds whereas his sons' daughters produced 975.64 pounds. Or to take a reverse case Homestead Girl DeKol Sarcastic Lad's daughters produced 795.37 pounds whereas the average of his son's daughters was only 591.50 pounds. This feature of the work needs more extensive treatment.

Conclusions

This paper is a preliminary paper on the performance of the progeny of Holstein-Friesian advanced registry sires with 365 day records to ascertain the nature of the transmitting power of

these sires for milk yield, butter-fat percentage and butter-fat, the whole to be put in easily understandable, numerical terms. The major objects sought are (1) to determine for each sire the mean or average milk yield of his daughters; (2) to determine for each sire the mean butter-fat percentage of his daughters; (3) to determine the mean butter-fat yield of his daughters; (4) to determine the mean milk yield, butter-fat percentage and butter-fat of all sires as shown by their sons' daughters' performance; (5) pedigree analysis of the sires with daughters, which are significantly high in their milk yield and butter-fat percentage in comparison with those whose daughters are significantly low in their milk yield and butter-fat per cent; (6) pedigree analysis of a random sample of sires without advanced registry daughters.

The age corrected milk yield and butter-fat percentage of all the 365 day records were divided at eight points such that these points separated the whole number or population of these cows into eight parts of equal number of cows. These divisions are called octiles and the points of division are shown in tables 2 and 4. The eight octiles are designated by letters. The letter *I* represents the cows which have the highest milk yield or butter-fat percentage. The letter *J* represents those which have the next highest milk yield or butter-fat percentage and progressing down the alphabet each letter representing a lower group until the letter *P*, the lowest producers, is reached.

The probable errors of the sire's progeny performance are derived from the standard deviation of the corrected milk yield and butter-fat percentage. These probable errors are shown in table 5. Since the probable error of the determination for a sire with a single daughter is so large the study herein presented, is limited to only those sires who have two or more daughters.

By the use of these methods three tables have been formed. The first table, No. 6, gives the necessary information to reveal the progeny performance for the milk yield of the daughters of each sire. The second table, No. 14, shows the information necessary to show the progeny performance for butter-fat percentage of each sire's daughters. The third table, No. 22, determines the progeny performance test for butter-fat for each sire's daughters.

There are 449 Holstein-Friesian sires which meet the requirements of this test. The average yearly milk yield of the

sire's daughters range from 28401.7 to 13006.0 pounds.

If a comparison is made between the average record of the different daughters of a sire and the average record of the race, 48 sires are found which have the progeny performance of their daughters sufficiently high to make it probable that their record is significantly above that of the race.

There are 29 sires with a sufficient number of daughters whose average milk yield is low enough to make it significantly below the mean of the advanced registry cows. There are no sires who have enough daughters with an average milk yield low enough to be more than significantly below the rest of the breed.

A study of the inbreeding and relationship, as shown in four generation pedigrees, has been made for these two groups of sires, (1) those with daughters of high average milk yield; (2) those with daughters of low average milk yield. The data accruing from this study were contrasted for the two groups with the forthcoming results. In the first group (1) there were 4.1 per cent of the total number of sires which showed inbreeding in the second; 20.8 per cent in the third and 64.5 per cent in the fourth generation. In the second group (2) there were 0.0 per cent in the second, 10.4 per cent in the third and 55.2 per cent in the fourth generation which showed inbreeding in their pedigrees. These results indicated that the sires whose daughters are the significantly high producers more frequently show inbreeding in their pedigrees than those sires whose daughters are significantly low producers.

The study of the pedigrees for the amount of inbreeding showed the following inbreeding coefficients for the first group of sires (1), second generation 1.04, third generation 3.12, fourth generation 8.74 and for the total inbreeding 6.52. The amount of inbreeding for the second group of sires (2) was 0.0 for the second generation, 1.29 for the third, 5.40 for the fourth and 3.04 for the total inbreeding. The amount of inbreeding in the pedigrees of sires whose daughters are high milk producers is shown by these coefficients to be nearly double that of the sires of low producing daughters. Judged by the probable error these differences are not significant, however.

The amount of relationship between the sire and dam of the first group of sires (1) is 2.08 per cent for the second, 5.21 per

cent for the third and 10.41 per cent for the fourth. For the second group of sires these coefficients are 0.0, 1.72 and 4.74. These results indicate a relationship between the sire and dam of the sires whose daughters are high producers, over twice as great as is shown by the sires whose daughters are low producers. The differences are so low, however, that they are not significant.

Study of the inbreeding and relationship of a random sample of sires without advanced registry daughters show that they were slightly more inbred than the sires with daughters of significantly high milk yield and considerably more inbred than the sires with daughters of significantly low milk yield. The relationship between the sire and dam of the random sample sires was slightly greater than the relationship between the sire and dam of the sire of high milking cows and twice as great as the sire of low testing cows. In no case were the differences large enough to be significant. These facts show that as ordinarily carried on, inbreeding and relationship are not detrimental to the animal.

Investigation of the pedigrees of these two groups of sires was made in order to determine which animals appear within each group. The findings indicated that, in general, both groups of pedigrees contained the same animals and in about equal proportions. Thus Paul DeKol for the bulls appeared in the pedigrees of the sires with high testing daughters 26 times, DeKol 2d for the cows appeared in this group 28 times. The pedigrees of the sires of low producing daughters showed these animals to appear 12 times in the case of Paul DeKol and 24 times in the case of DeKol 2d. When the number of pedigrees in each group 48 and 29 is taken into consideration it is clear that these animals appear in about equal proportions.

Comparison of the animals appearing in the random sample pedigrees showed that they appear in about equal proportions in the other pedigree groups.

Correlations have been worked out for the animals appearing in these two groups of pedigrees including the division of those which occurred on the sire's and dam's side of the pedigree. These correlations coefficients range from +0.090 to .657. The range of the correlation coefficients for the animals appearing in the random sample pedigrees with those appearing in the

pedigree groups of the sires of high and low milking cows is +0.165 to .504. They show that the animals appearing in one group are highly correlated with those appearing in the other groups. Such being the case the question may be asked, how can a breeder determine from a pedigree what sires are going to be those which will have high producing daughters? In the present light of our knowledge the answer appears to be that he cannot.

There are 449 Holstein-Friesian sires who meet the requirements for the butter-fat percentage. The yearly butter-fat percentage for the average of the sires' daughters ranges from 4.503 per cent to 2.820 per cent.

Comparison of the sires in table 14 with the average of the advanced registry cows in conjunction with the probable errors of table 5 shows that 22 sires have an average butter-fat percentage for their daughters which is sufficient to be significantly high. Six of these 22 sires have a sufficient number of daughters with a high enough butter-fat test as to be distinctly significant.

There are 22 sires with a sufficient number of daughters whose average butter-fat test is low enough to make the test significantly below the mean of the advanced registry cows.

A four generation pedigree study of these two groups of sires was made to determine the effect of inbreeding and of relationship within the pedigree, on the butter-fat percentage. The two groups are (1) the sires whose daughters' average butter-fat percentage is significantly above the mean of the advanced registry cows; (2) the sires whose daughters' average butter-fat percentage is significantly below the mean of the advanced registry cows.

In the first group 4.5 per cent of the sires showed inbreeding, in the second generation, 18.1 per cent in the third generation and 68.1 per cent in the fourth generation. The proportionate number of sires which show inbreeding in the group for high butter-fat percentage as compared with that for high milk is consequently approximately the same.

The second group, or the sires with low testing daughters, had 0.0 per cent in the second generation, 18.1 per cent in the third generation and 63.6 per cent in the fourth generation, of their number inbred. The number within this group which are

inbred compare favorably with those in the group (1) of sires with high daughters as given above.

The amount of inbreeding which these two groups of sires exhibit is nearly twice as much for those sires whose daughters are high in their butter-fat test as compared with those whose daughters are low in their butter-fat test. The figures for the different generations are 1.14 per cent for the first group (1) to 0.0 per cent for the second group (2) in the second generation; 3.41 (1) to 2.2 for the third generation; 8.82 (1) to 6.95 (2) for the fourth generation. The total inbreeding for the high testing group is 6.39 to 3.86 for the low testing group. In no case are the differences significant.

The relationship between the sire and dam of the group of sires of high testing daughters is nearly twice as great as it is for the sires of low testing daughters. The average coefficient for the high testing group is 2.27 for the second; 6.82 per cent for the third and 11.93 per cent for the fourth generation compared with 0.0 per cent for the second, 2.27 per cent for the third and 6.25 for the fourth generation for those sires whose daughters are low in butter-fat percentage.

Comparison of these results for high and low butter-fat percentage advanced registry sires with those of a random sample of the sires without advanced registry daughters as shown in table 10 shows that the random sample sires have a greater proportion of their number inbred than the advanced registry sires of high testing daughters or the sires of low butter-fat percentage daughters. If the amount of inbreeding within the group of random sample sires is compared with the amount in the sires of high butter-fat percentage daughters or the sires of low testing daughters it is found that the random sample sires are slightly more inbred. The comparison of the relationship which exists between the sire and dam of the sires within the three groups shows the random sample sire to have slightly more related parents. The differences are not very significant, however.

These facts argue for the belief that inbreeding as normally carried on within the Holstein-Friesian breed has no detrimental effect on milk yield or butter-fat percentage of the daughters of a given sire.

Analysis of the pedigrees of sires whose daughters are high in their butter-fat percentage for the animals contained therein,

shows that they contain many of the same animals as the pedigrees of the sires whose daughters are low in their butter-fat percentage. A similar comparison of the animals occurring in the pedigrees of the random sample sires shows that most of these animals also occur in the pedigrees of the two advanced registry groups of sires and in approximately the same proportion.

Each pedigree group and for the division, sire's side and dam's side of the pedigree have been analyzed for the appearances of the animals between them. The close similarity between the animals appearing in the pedigrees of high milking group and the low milking group with those of the average pedigree group shows that the appearance of a bull in the pedigree of the high group is no necessary guide to that animal's worth. The fact that a bull whose progeny performance is unknown has a well known bull or bulls in his pedigree is, unfortunately, no indicator of that unknown bull's worth so far as milk production is concerned. Comparison of the animals appearing in the pedigrees of the sires whose daughters' butter-fat percentage is high with those appearing in the pedigrees of the sires whose daughters' butter-fat percentage is low, shows the number appearing in both groups to be less by a slightly significant amount. Such a slightly significant difference indicates to a slight degree that the appearance in the pedigree of an unknown sire of a bull which is known to appear frequently in the pedigrees of sires of high butter-fat percentage daughters is an indication of the worth of the unknown bull as a sire of high butter-fat testing daughters.

The frequency of the appearance of the same animals is significantly greater between groups (high milk yield, low milk yield, high butter-fat percentage and low butter-fat percentage) for those animals on the sire's side of the pedigree than between groups for those animals appearing on the dam's side of the pedigree. From this, it would seem that more attention is being paid by the breeder to the sire's side of the pedigrees than is being paid to the dam's side of the pedigree.

A greater kinship is indicated between the animals on the sire's side of the pedigrees for the different groups than exists between the animals on the sire's and dam's side of the pedigrees for the same group.

Comparison of the animals appearing in the pedigrees of a random sample of the breed's sires with those appearing in the four groups of advanced registry sires shows that the animals in pedigrees of the random sample group are somewhat less frequently found in the pedigrees of the four other advanced registry groups. They are not enough less, however, to preclude the probability that the differences come from random sampling. Such being the case there seems to be no significant difference between the pedigrees of a random sample of Holstein-Friesian bulls without advanced registry daughters and the Holstein-Friesian bulls with advanced registry daughters.

There are 449 sires in the table 22 showing the progeny performance test of Holstein-Friesian sires for butter-fat. Examination of table 22 in conjunction with table 5 shows that there are 37 sires whose daughters' butter-fat production is sufficiently high to make it significantly above that of the race. The sires, King Hengerveld Aaggie Fayne, Friend Hengerveld DeKol Butter Boy, King Segis Pontiac Count, Pontiac Aaggie Korndyke and King of the Pontiacs have enough daughters with a sufficinetly large average butter-fat yield to make their production quite significantly high.

There are 19 sires who have enough daughters with an average butter-fat yield to make their record significantly low.

There are 263 sires who have one or more sons with year test daughters. These sons are gathered together under their sires in table 19. The average milk yield, butter-fat percentage and butter-fat is determined for each son's daughters, for the sire's daughters and for the average of the sire's sons. The sire, King Fayne Segis with three sons has the highest average butter-fat percentage for his sons. The average is 1029.85 pounds of butter-fat for the age corrected yield. The sire whose son has the lowest performance is Netherland Portage Paul DeKol.

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